November 2009

# VSD Series Quick Start Guide

*Open Drive*

*Bypass Drive*

*NEMA Type 12*

*NEMA Type 3R*

**IMPORTANT:** This guide is intended to provide a quick reference to the VSD Series drive's Application Software features for start-up, programming and service. It does not replace the need to thoroughly read and understand the User Manual.

## Table of Contents


| *Description* | *Page* |
|---|---|
| NEMA Type 1/12 Open Drives (1 – 250 HP) | **2** |
| NEMA Type 1 IntelliPass/IntelliDisconnect Drive | **5** |
| Enclosed NEMA Type 12/3R | **10** |
| Appendix A — Main Control Board Wiring | **15** |
| Appendix B — Interlock Damper Start Example Using 4 – 20 mA Control Signal | **16** |
| Appendix C — Interlock Damper Start Example Using PID Duct Static Control Signal | **17** |
| Appendix D — Bypass Wiring Diagram | **18** |
| Appendix E — Keypad Navigation | **19** |
| Appendix F — Main Menu Navigation | **20** |
| Appendix G — Start-Up Wizard | **21** |
| Appendix H — Static Checking | **25** |
| Appendix I — Fault and Warning Codes | **27** |


***Technical Support Phone Numbers***

Branch: 800-281-3792 (Option 1)

Third Party (ABCS/DIST): 800-445-4757 (Option 1)

***General***

Upon receipt of the unit, verify that the catalog number and unit options stated on the shipping container match those stated on the order/purchase form.

Inspect the equipment upon delivery. Report any carton damage to the carrier prior to accepting the delivery. Have this information noted on the freight bill. Johnson Controls is not responsible for damage incurred in shipping.

***Unpacking***

Remove all packing material from the unit. Be sure to remove all packing material from lug location. Also, make sure no packing material is left behind that would block the airflow to the fan.

Check the unit for any signs of shipping damage. If damage to the product is found after unpacking, report it to the freight company. Retain the packing materials for the carrier to review.

***Storage***

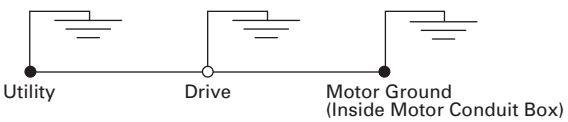
It is recommended that the unit be stored in its original shipping box/crate until it is to be installed.

The unit should be stored in a location where:

- The ambient temperature is between -40°F and 158°F (-40°C and 70°C)
- The relative humidity is between 0% and 95%, non-condensing
- The environment is dry, clean, and non-corrosive
- The unit will not be subjected to high shock or vibration conditions

***Mandatory Ground Wiring*** **(See Appendix D on Page 18)**

Be sure to pull low impendance ground wiring from customer power to drive and ground wire from drive to motor.



# NEMA Type 1/12 Open Drives (1 – 250 HP)

**Table 1: Control Wiring Instructions**

## Mounting Drive

1. Mount Drive
   (See Table below for dimensions.)

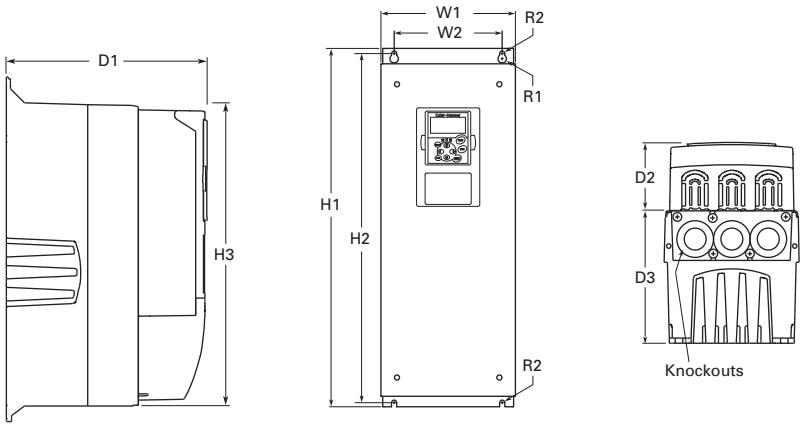



**Figure 1:**

**VSD Series Open Drive Dimensions**

| Frame Size | Voltage | hp (VT) | Approximate Dimensions in Inches (mm) | | | | | | | | | | Weight Lbs. (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | H1 | H2 | H3 | D1 | D2 | D3 | W1 | W2 | R1 dia. | R2 dia. | |
| FR4 | 230V | 3/4 – 3 | 12.9 (327) | 12.3 (313) | 11.5 (292) | 7.5 (190) | 2.5 (64) | 5.0 (126) | 5.0 (128) | 3.9 (100) | .5 (13) | .3 (7) | 11 (5) |
| | 480V | 1 – 5 | | | | | | | | | | | |
| FR5 | 230V | 5 – 7-1/2 | 16.5 (419) | 16.0 (406) | 15.4 (391) | 8.4 (214) | 2.7 (68) | 5.8 (148) | 5.7 (144) | 3.9 (100) | .5 (13) | .3 (7) | 17.9 (8.1) |
| | 480V | 7-1/2 – 15 | | | | | | | | | | | |
| FR6 | 230V | 10 – 15 | 22.0 (558) | 21.3 (541) | 20.4 (519) | 9.3 (237) | 2.7 (68) | 6.7 (171) | 7.7 (195) | 5.8 (148) | .7 (18) | .4 (9) | 40.8 (18.5) |
| | 480V | 20 – 30 | | | | | | | | | | | |
| | 575V | 2 – 25 | | | | | | | | | | | |
| FR7 | 230V | 20 – 30 | 24.8 (630) | 24.2 (614) | 23.3 (591) | 10.1 (257) | 2.7 (68) | 7.5 (189) | 9.3 (237) | 7.5 (190) | .7 (18) | .4 (9) | 77.2 (35) |
| | 480V | 40 – 60 | | | | | | | | | | | |
| | 575V | 30 – 40 | | | | | | | | | | | |
| FR8 | 480V | 75 – 125 | 29.7 (755) | 28.8 (732) | 28.4 (721) | 11.3 (288) | 1.3 (34) | 11.0 (279) | 11.2 (285) | 10.0 (255) | .7 (18) | .4 (9) | 127.8 (58) |
| | 575V | 50 – 75 | | | | | | | | | | | |
| FR9 | 480V | 150 – 200 | 45.3 (1150) | 44.1 (1120) | — | 14.3 (362) | 5.4 (137) | 8.8 (224) | 18.9 (480) | 15.7 (400) | .7 (18) | .4 (9) | 321.9 (146) |
| | 575V | 100 – 150 | | | | | | | | | | | |
| FR10 | 480V | 250 – 350 | 44 (1120) | 33.5 (850) | — | 23.6 (600) | NA | NA | 23.6 (600) | 16.7 (425) | .9 (23) | .47 (12) | 550.7 (250) |
| | 575V | 200 – 300 | | | | | | | | | | | |

## Power Wiring

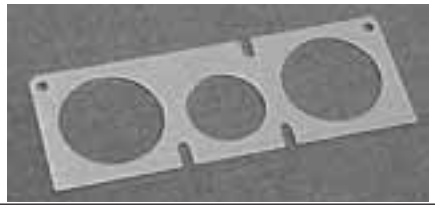
**Notice**

**Do not discard the plastic bag containing the wiring plate.**

2. Remove the bottom cover by rotating the cover toward you on the base hinges, then lifting the cover away from the base.

## Power Wiring

3. Locate the plastic bag shipped with the drive containing the wiring plate, and remove the wiring plate.



# NEMA Type 1/12 Open Drives (1 – 250 HP)

**Table 1: Control Wiring Instructions (continued)**

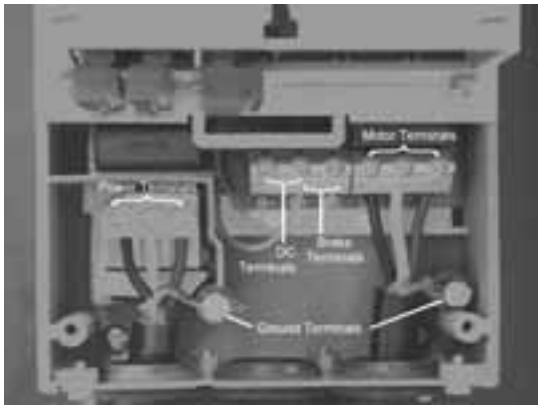
### Power Wiring

4. If conduit is being used, attach the wiring plate to it.
5. Pass the motor and input power wires/cables through the holes of the wiring plate.
6. If shielded cable is used, connect the shields of the input line power cable and the motor cable to the motor and power ground terminals of the VSD Series drive.

### Power Wiring/Grounding

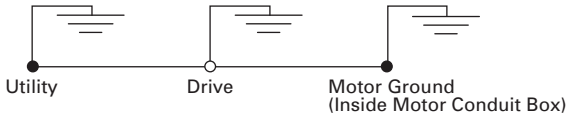
7. Wire power terminals, motor terminals, and grounding terminals per diagram. Power and Motor leads must be in separate conduit.

**Note:** Do not wire motor loads to B- B+ R-. This will cause damage.




## GROUND WIRING

- Run motor cables in separate conduit.
- DO NOT RUN CONTROL WIRES in same conduit
- Cables sized per NEC.
- Provide low impedance ground between drive and motor.



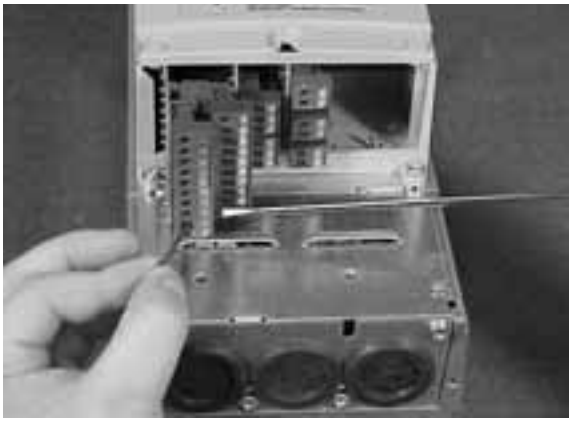

**IMPORTANT:** Improper grounding could result in damage to the motor and/or drive and could void warranty

### Control Wiring

8. Wire the control terminals following the details for the specific option boards shown on the following pages.

**Note:** For ease of access, the option board terminal blocks can be unplugged for wiring.

**Note:** If using conduit or Seal Tite for control wiring for Frame 4, you must order NEMA Type 12 kit.



# NEMA Type 1/12 Open Drives (1 – 250 HP)

**Table 1: Control Wiring Instructions (continued)**

## Control Wiring

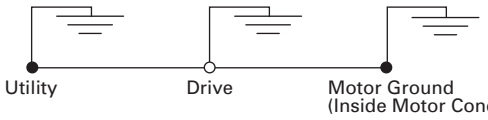
9. Wire control to the OPTA9 Control Board and OPTA2.

**Note:** Drive default is programmed for Damper Interlock.

**Note:** Option Boards OPTC2 (N2/XT/SA Bus) and OPTC4 (LonWorks) are optional.

### *Mandatory Ground Wiring*

Be sure to pull low impendance ground wiring from customer power to drive and ground wire from drive to motor.




### *I/O Connection*

- Run 110 Vac and 24 Vdc Control wiring in separate conduit.
- Communication wire to be shielded.
- RS-232 Keypad cable less than 20 feet.

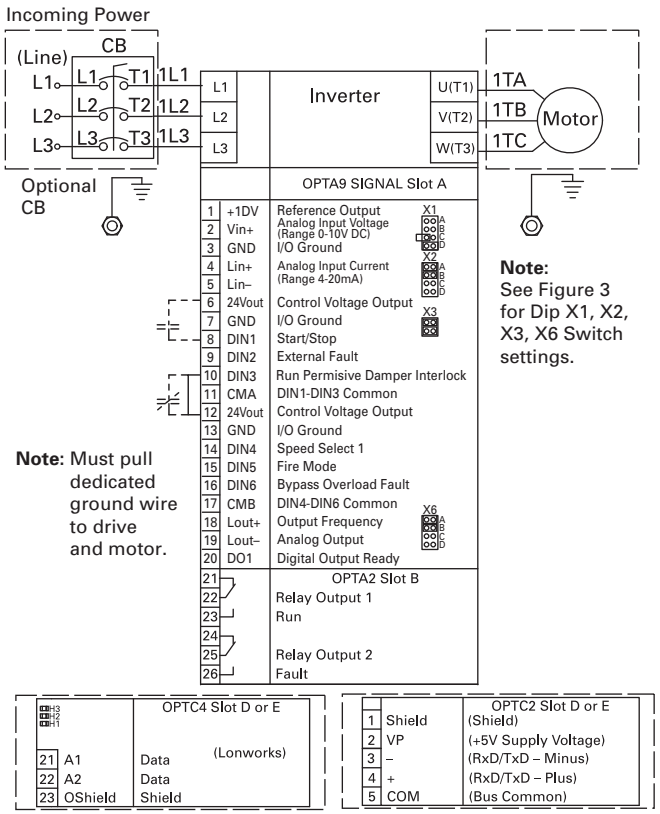



**Figure 2:**

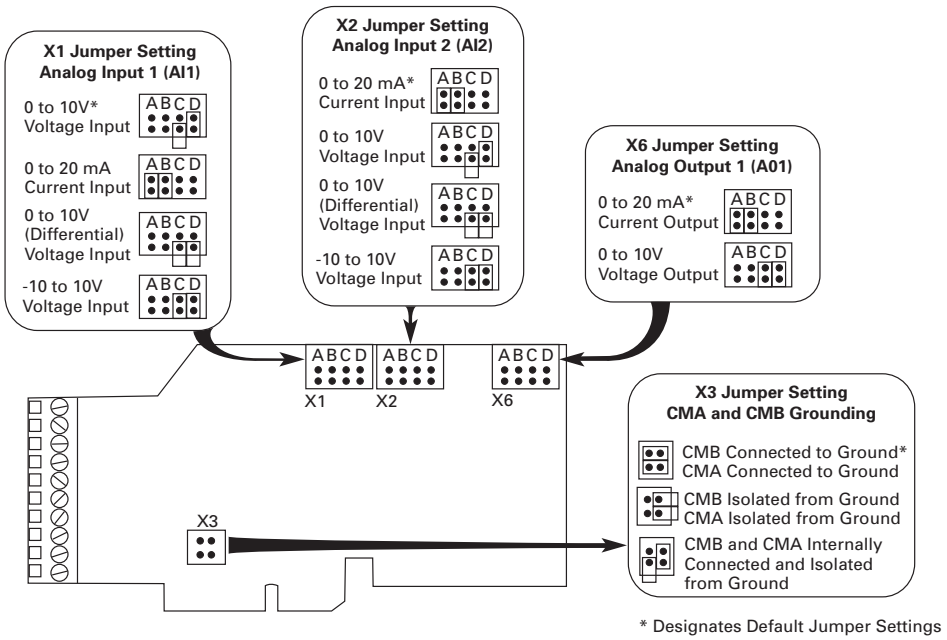

X1 Jumper Setting
Analog Input 1 (AI1)
0 to 10V* Voltage Input
0 to 20 mA Current Input
0 to 10V (Differential) Voltage Input
-10 to 10V Voltage Input
X2 Jumper Setting
Analog Input 2 (AI2)
0 to 20 mA* Current Input
0 to 10V Voltage Input
0 to 10V (Differential) Voltage Input
-10 to 10V Voltage Input
X6 Jumper Setting
Analog Output 1 (A01)
0 to 20 mA* Current Output
0 to 10V Voltage Output
A B C D
X1
X2
X6
X3
X3 Jumper Setting
CMA and CMB Grounding
CMB Connected to Ground*
CMA Connected to Ground
CMB Isolated from Ground
CMA Isolated from Ground
CMB and CMA Internally Connected and Isolated from Ground
* Designates Default Jumper Settings

**Figure 3: Option Board A9 Location and Settings**

| | |
|---|---|
| **Start-Up Wizard** | See **Appendix G**. |

# NEMA Type 1 IntelliPass/IntelliDisconnect Drive

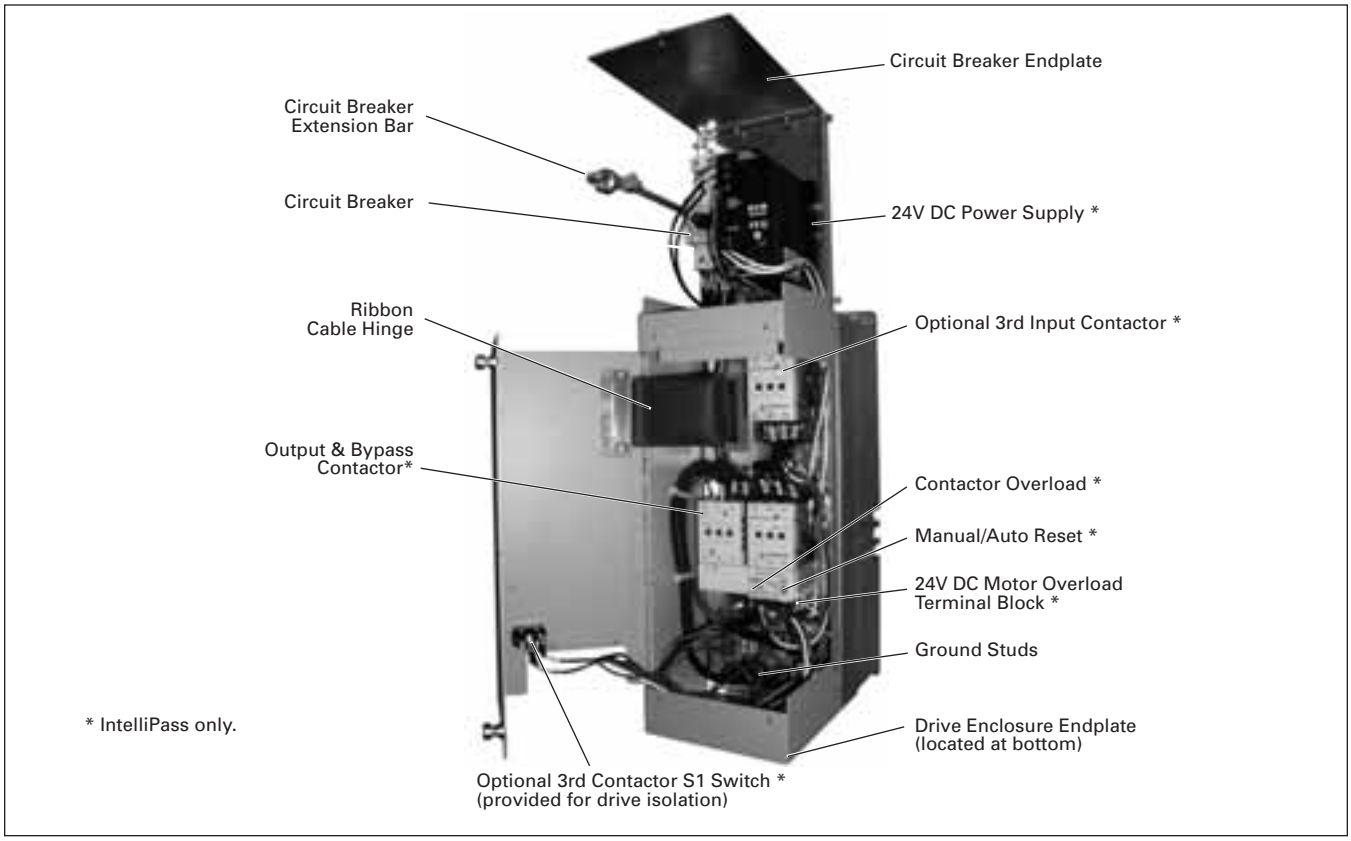

Circuit Breaker Endplate
Circuit Breaker Extension Bar
Circuit Breaker
24V DC Power Supply *
Ribbon Cable Hinge
Optional 3rd Input Contactor *
Output & Bypass Contactor*
Contactor Overload *
Manual/Auto Reset *
24V DC Motor Overload Terminal Block *
Ground Studs
* IntelliPass only.
Drive Enclosure Endplate (located at bottom)
Optional 3rd Contactor S1 Switch * (provided for drive isolation)

**Figure 4: Identification of NEMA Type 1 Components**

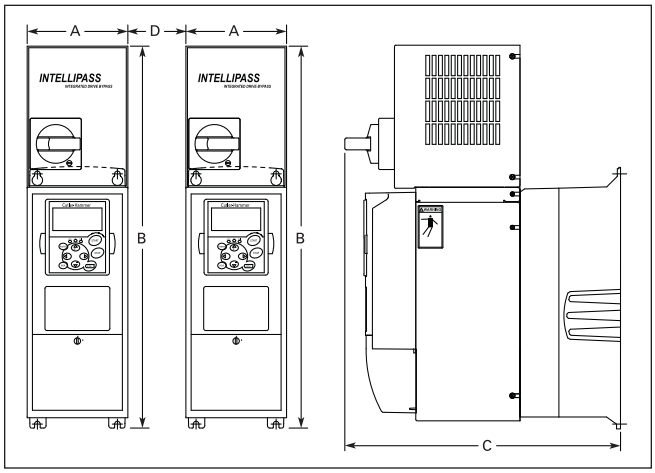



**Figure 5: VSD Series IntelliPass/IntelliDisconnect Drive Dimensions**

**Table 2: VSD Series NEMA Type 1 IntelliPass/IntelliDisconnect Drive Dimensions**

| Drive Horsepower (VT) | Frame Size | Approximate Dimensions in Inches (mm) | | | Approx. Weight in lbs. (kg) | Distance Between Drives in Inches (mm) ① |
|---|---|---|---|---|---|---|
| | | A | B | C | | D |
| 208V, 1 – 3 hp<br>230V, 1 – 3 hp<br>480V, 1 – 7-1/2 hp | FR4 | 5.04 (128) | 18.25 (464) | 13.24 (336) | 21 (9.5) | 5.3 (134.6) |
| 208V, 5 – 7-1/2 hp<br>230V, 5 – 10 hp<br>480V, 10 – 20 hp | FR5 | 5.50 (140) | 23.25 (591) | 13.24 (336) | 35 (15.9) | 5.7 (144.8) |
| 208V, 10 – 20 hp<br>230V, 15 and 20 hp<br>480V, 25 – 40 hp | FR6 | 7.50 (191) | 29.38 (746) | 15.25 (387) | 67 (30.4) | 7.5 (190.5) |
| 208V, 25 and 30 hp<br>230V, 25 and 30 hp<br>480V, 50 – 75 hp | FR7 | 9.10 (231) | 37.53 (953) | 15.25 (387) | 108 (49.0) | 9.0 (228.6) |

① If mounting two or more IntelliPass Drives next to each other, make sure to use the proper spacing between the drives for hinged door operation.

# NEMA Type 1 IntelliPass/IntelliDisconnect Drive

**Table 3: Bypass Power Wiring Instructions — NEMA Type 1**

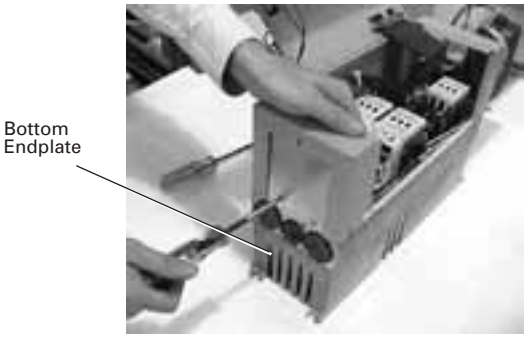
### Mounting Drive

1. Mount drive per dimensions. (See **Page 5**.)
2. Verify that the main power source is removed upstream.
3. Using a flat-blade screwdriver, remove the four screws securing the outer cover of the drive and remove the cover.
4. Using the same screwdriver, remove the two center screws securing the side cover.
5. Make sure there is adequate room, and open the hinged side cover.

### Power Wiring

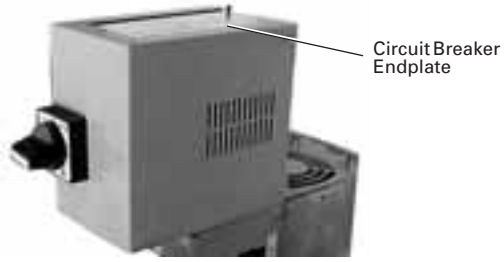
6. Using a flat-blade screwdriver, remove the screws securing the endplate at the bottom of the drive enclosure, and remove the endplate.
7. Using a Greenlee conduit cutter (recommended), cut one or more holes in the endplate, located at the bottom of the drive's enclosure, for the motor and power leads.

**Note:** If bringing the power leads in through the top of the drive's enclosure, go to step 8. If not, proceed to step 10.




### Power Wiring

8. Using a flat-blade screwdriver, remove the screws securing the endplate for the circuit breaker enclosure, and remove the endplate.
9. Using a Greenlee conduit cutter (recommended), cut one hole in the circuit breaker endplate for the power leads.

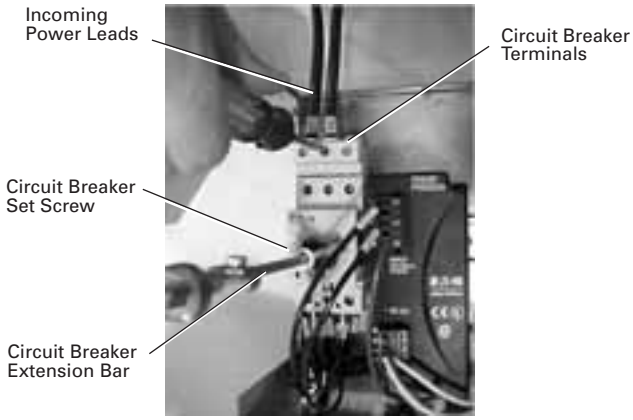



### Power Wiring

10. Calibrate the circuit breaker amperage, so it is 1.25 times the amperage on the motor nameplate, by turning the red set screw located below the circuit breaker extension bar. See the circuit breaker user's manual supplied with the drive.
11. Connect the incoming power leads to circuit breaker terminals labeled L1, L2 and L3. Cables sized per NEC.
12. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.

## POWER WIRING

- Run cabling in separate metal conduit or wiring tray.
- DO NOT RUN CONTROL WIRING with incoming power wiring.
- Provide low impedance ground connection to drive chassis.
- DO NOT CONNECT to B+, B-, R terminals.



# NEMA Type 1 IntelliPass/IntelliDisconnect Drive

**Table 3: Bypass Power Wiring Instructions — NEMA Type 1 (continued)**

### Motor Wiring

13. Use your first and second fingers and simultaneously push down to release the two orange retaining clips (one on each side of the 24V DC motor overload terminal block).
14. If necessary, use a flat-blade screwdriver to carefully remove the terminal block in a straight plane to avoid damaging it.

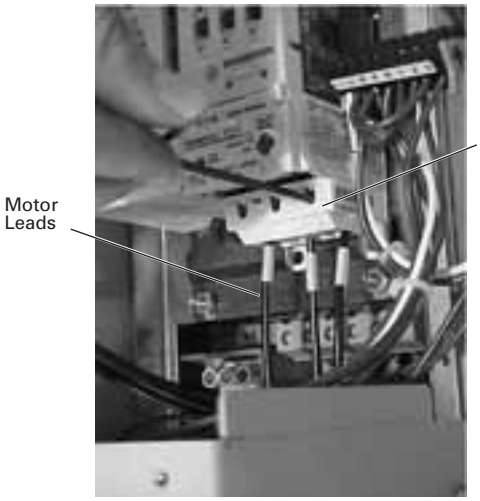
### Motor Wiring

15. Connect the motor leads to the motor overload terminals labeled 1TA, 1TB and 1TC.
16. Using the appropriate **metric** Allen wrench (2.5 mm, 3 mm or 4 mm), tighten each overload terminal per the specifications in the contactor user's manual.

## MOTOR WIRING

**An SAE allen wrench will damage the terminals, and the motor overload will need to be replaced (not covered by warranty).**

17. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.
18. Reinsert the motor overload terminal block.

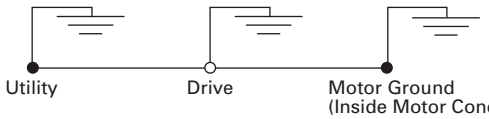



### Grounding

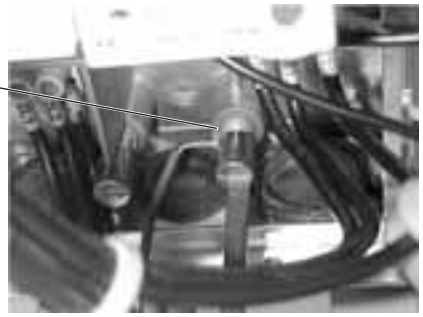
19. Use a flat-blade screwdriver to connect the motor ground wire to the ground stud (located at either the top or bottom of the drive's enclosure). (Mandatory) Ground connection main power ground must be connected to other ground screws.

## GROUND WIRING

- Run motor cables in separate conduit.
- DO NOT RUN CONTROL WIRES in same conduit
- Cables sized per NEC.
- Provide low impedance ground between drive and motor.




**IMPORTANT:** Improper grounding could result in damage to the motor and/or drive and could void warranty



# NEMA Type 1 IntelliPass/IntelliDisconnect Drive

**Table 3: Bypass Power Wiring Instructions — NEMA Type 1 (continued)**

### Setting Overload

20. Lift to open the cover on the motor overload, and use a 1/8" flat-blade screwdriver to set the overload amperage to match the value on the motor nameplate.
21. Turn the auto/manual reset (factory default is manual) on the motor overload 90° to the auto position.

### Control Wiring

22. Use a flat-blade screwdriver to carefully remove the low-voltage I/O terminal block.
23. Insert the incoming control leads into the terminal block. Refer to the electrical schematic supplied with the drive.
24. Reinsert the I/O terminal block into the control board.
25. Verify that all other wires to the terminal block are connected.
26. Terminate control wiring to the OPTA9 and OPTA2 board (Terminals 1 – 26).

## CONTROL WIRING

- Run 110 Vac and 24 Vdc control wiring in separate conduit.
- Communication wire must be shielded.
- RS-232 keypad cable must be less then 25 feet.

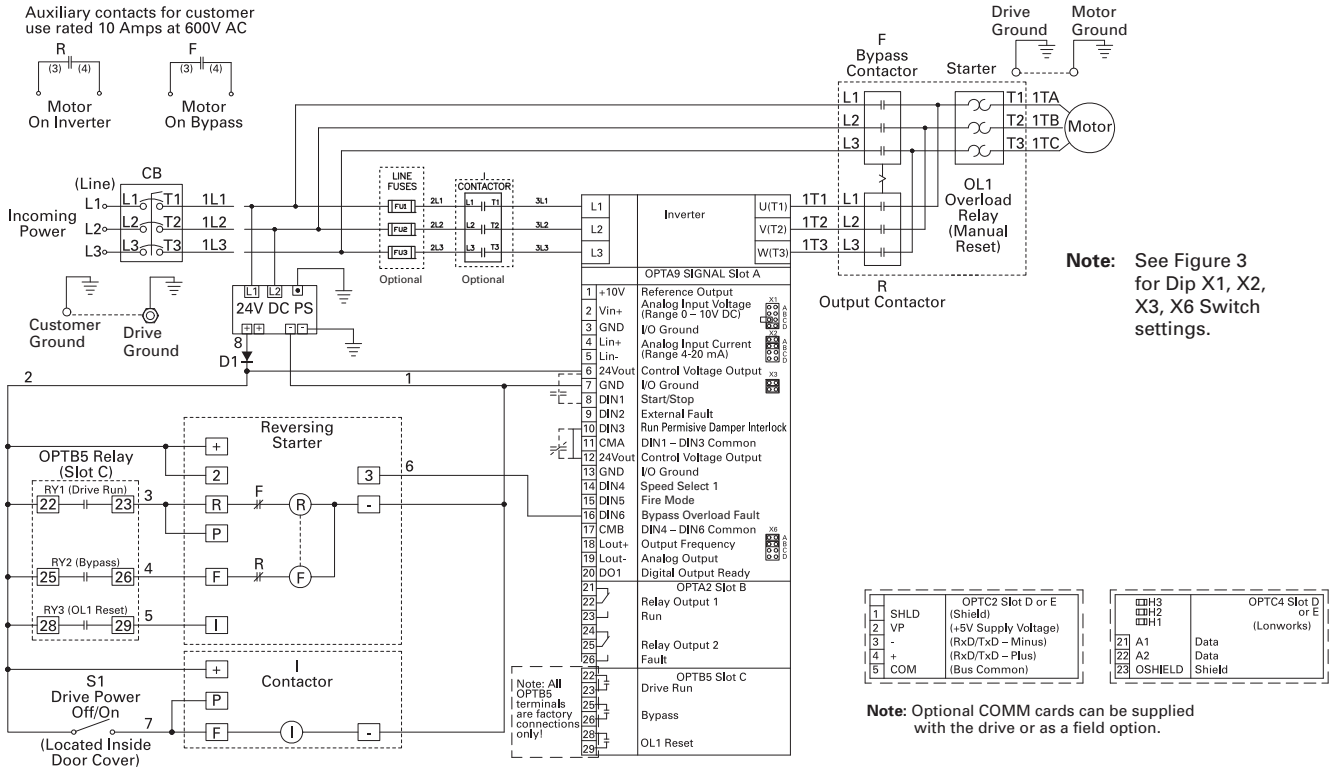



**Figure 6: VSD Series IntelliPass with Three Contactors**

# NEMA Type 1 IntelliPass/IntelliDisconnect Drive

**able 3: Bypass Power Wiring Instructions — NEMA Type 1 (continued)**

| | |
|---|---|
| **Static Check**<br>27. Make sure power is off, and perform static checks as described in **Table 7** (for the converter), **Table 8** (for the inverter) and **Table 9** (for the DC bus). Refer to **Page 25**, **Appendix H**.<br>**Note:** Static check shown is for L3 and B+ terminals.<br>28. Once the pre-power static checks are completed, reinstall the drive's outer and side covers, tightening all the screws.<br>**⚠ WARNING**<br>High Voltage is present on L1, L2, L3, B-, B+, BT, T1, T2, T3. | |
| **Starting Drive**<br>29. Make sure that the drive's 3rd contactor S1 switch, if present, is in the ON position (shown in OFF position).<br>**Note:** The bypass mode operates with the switch in the OFF position, however the drive will not run. Yet the keypad will operate. | |
| **Starting Drive**<br>30. Turn the circuit breaker handle in a clockwise direction.<br>**⚠ WARNING**<br>High Voltage<br>• Always work with another person.<br>• Be sure equipment is properly grounded.<br>• Wear safety glasses. | |
| **Start-Up Wizard** | See **Appendix G**. |

# Enclosed NEMA Type 12/3R

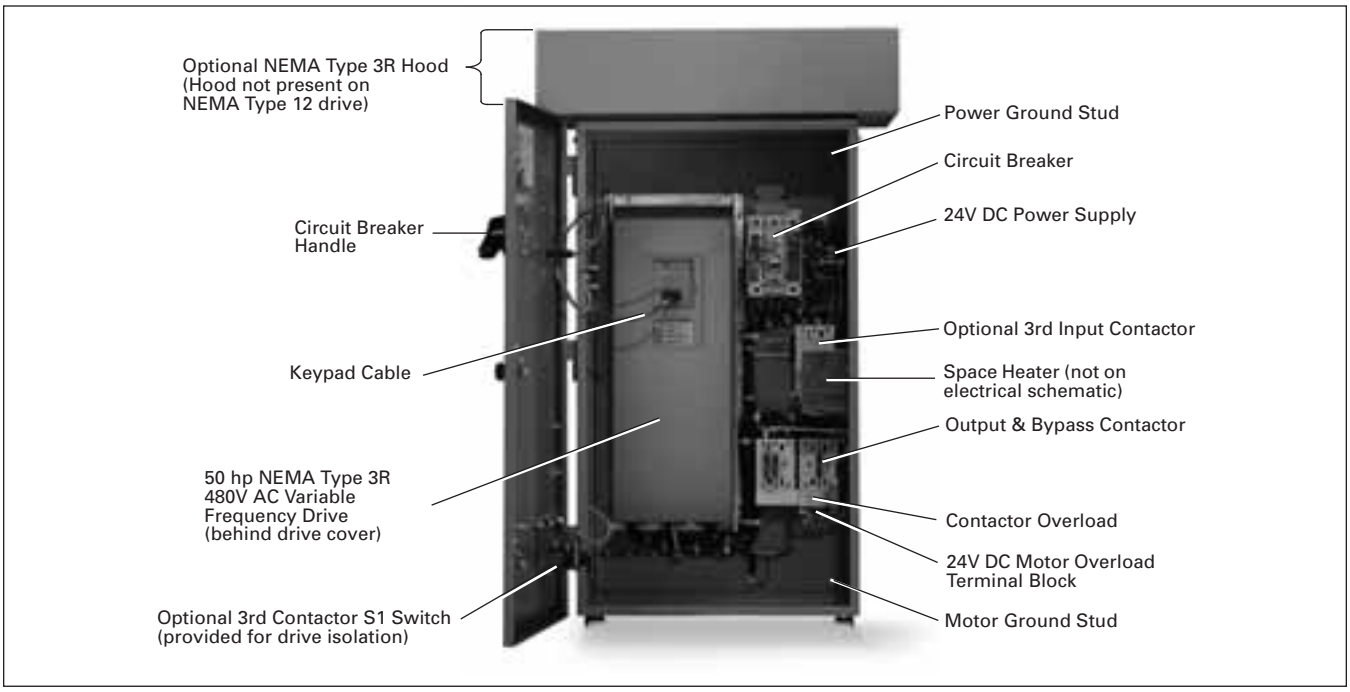



**Figure 7: Identification of NEMA Type 12 and NEMA Type 3R Components**

**Note**: You will need to consult the electrical schematic supplied with the drive and the appropriate wiring diagram in Appendix D.

**Table 4: VSD Series NEMA Type 12 Enclosed IntelliPass Drive Dimensions**

| Drive Horsepower (VT) | Frame Size | Enclosure Box | Approximate Dimensions in Inches (mm) | | |
|---|---|---|---|---|---|
| | | | A | B | C |
| 208V, 1 – 15 hp<br>230V, 1 – 15 hp<br>480V, 1 – 30 hp<br>575V, 3 – 30 hp | FR4 – FR6<br>FR4 – FR6<br>FR4 – FR6<br>FR6 | A | 16.92<br>(429.8) | 29.00<br>(736.6) | 18.60<br>(472.4) |
| 208V, 20 – 30 hp<br>230V, 20 – 30 hp<br>480V, 40 – 75 hp<br>575V, 40 – 50 hp | FR6 – FR7 | B | 20.92<br>(531.3) | 40.00<br>(1016.0) | 19.10<br>(485.1) |
| 208V, 40 – 60 hp<br>230V, 40 – 60 hp<br>480V, 100 – 150 hp | FR8 | C | 30.92<br>(785.3) | 52.00<br>(1320.8) | 19.10<br>(485.1) |

① Floor Stands available on Box C only and can be purchased and shipped separately as kit.

**Table 5: VSD Series NEMA Type 3R Enclosed IntelliPass Drive Dimensions**

| Drive Horsepower (VT) | Frame Size | Enclosure Box | Approximate Dimensions in Inches (mm) | | |
|---|---|---|---|---|---|
| | | | A | B | C |
| 208V, 1 – 15 hp<br>230V, 1 – 15 hp<br>480V, 1 – 30 hp<br>575V, 3 – 30 hp | FR4 – FR6 | A | 21.05<br>(534.7) | 33.00<br>(838.2) | 19.57<br>(497.0) |
| 208V, 20 – 30 hp<br>230V, 20 – 30 hp<br>480V, 40 – 75 hp<br>575V, 40 – 50 hp | FR6 – FR7 | B | 26.31<br>(668.3) | 46.09<br>(1170.7) | 20.07<br>(509.9) |
| 208V, 40 – 60 hp<br>230V, 40 – 60 hp<br>480V, 100 – 150 hp | FR8 | C | 37.73<br>(958.3) | 58.09<br>(1475.5) | 20.08<br>(510.0) |

② Floor Stands available on Box C only and can be purchased and shipped separately as kit.

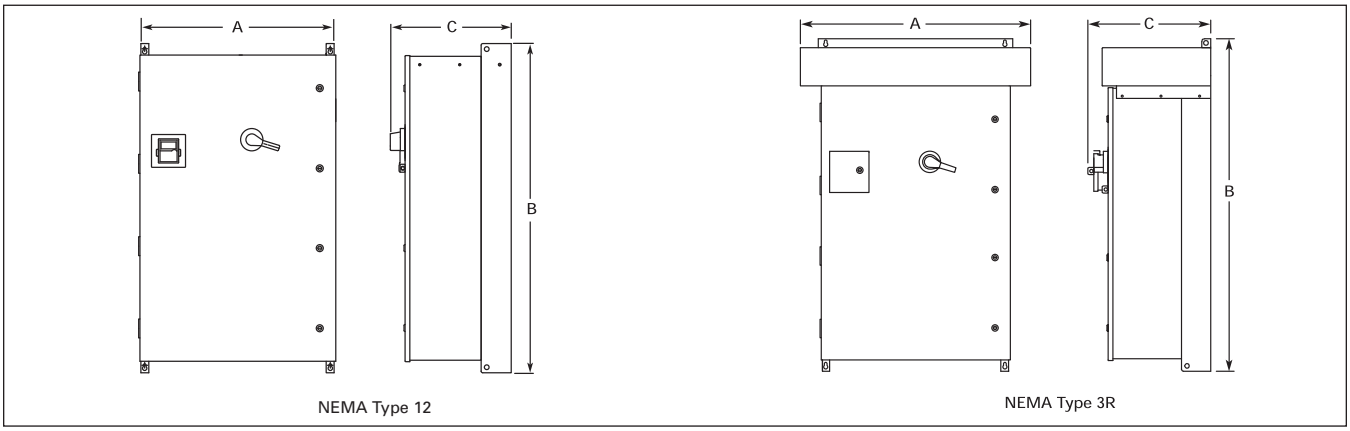



**Figure 8: VSD Series Enclosed Drive Dimensions**

# Enclosed NEMA Type 12/3R

**Table 6: Bypass Power Wiring Instructions — NEMA Type 12/3R**

### Mounting Drive

1. Mount drive per dimensions. (See Page 10.)
2. Verify that the main power source is removed upstream.
3. Remove the keypad cable from the drive.
4. Remove the screws from the drive cover, and remove the cover.

**⚠ CAUTION**

The circuit breaker extension bar is sharp and can cause injury.

5. Calibrate the circuit breaker amperage, so it is 1.25 times the value on the motor nameplate, by turning the red set screw located below the circuit breaker extension bar. See the circuit breaker user's manual supplied with the drive.

### Power and Ground Wiring

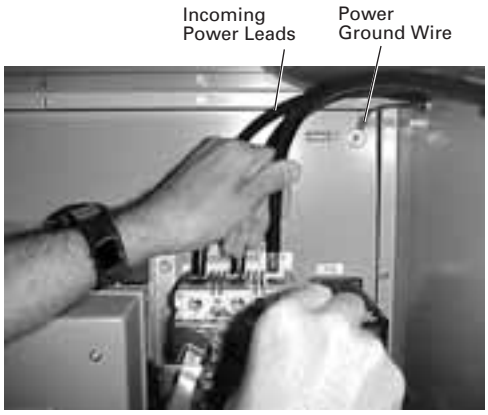
6. Using a Greenlee conduit cutter (recommended), cut three holes in the drive's enclosure for the incoming power, motor and low-voltage control leads.

**POWER WIRING**

**Note:** Power, motor and control leads must each be located in separate conduit.

- **DO NOT RUN CONTROL WIRING in same conduit with power wiring.**
- **Provide low impedance ground connection to drive chassis.**
- DO NOT CONNECT B+, B-, R terminal. (Reserved for Braking Resistor only.)

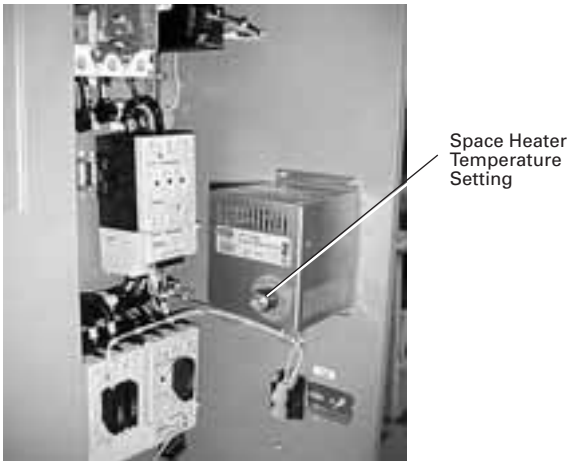
7. Connect the incoming power leads to circuit breaker terminals labeled L1, L2 and L3.
8. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.
9. Connect the power ground wire to the ground stud. Connect motor ground to ground stud.




### Setting Space Heater

10. If applicable, set the space heater. See the space heater user's manual supplied with the drive.

**Note:** The space heater is used to prevent condensation from damaging the equipment when the drive is not operating (OFF).

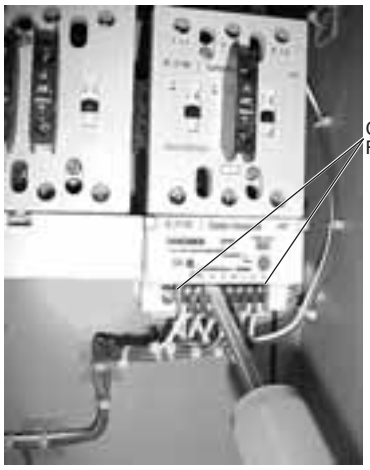


# Enclosed NEMA Type 12/3R

**Table 6: Bypass Power Wiring Instructions — NEMA Type 12/3R (continued)**

### Motor Wiring

11. Use your first and second fingers and simultaneously push down to release the two orange retaining clips (one on each side of the 24V DC motor overload terminal block).
12. If necessary, use a flat-blade screwdriver to carefully remove the terminal block in a straight plane to avoid damaging it.




### Setting Motor Overload

13. Lift to open the cover on the motor overload, and use a 1/8" flat-blade screwdriver to set the overload amperage to match the value on the motor nameplate.
14. Turn the auto/manual reset (factory default is manual) on the motor overload 90° to the auto position.

### Motor Wiring

15. Connect the motor leads to the motor overload terminals labeled 1TA, 1TB and 1TC.
16. Using the appropriate **metric** Allen wrench (2.5 mm, 3 mm or 4 mm), tighten each overload terminal per the specifications in the contactor user's manual.

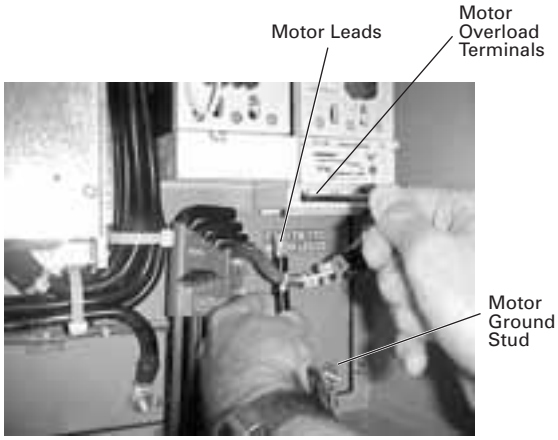
## MOTOR WIRING

**An SAE allen wrench will damage the terminals, and the motor overload will need to be replaced (not covered by warranty).**

17. Using the torque wrench, tighten each terminal to the torque value found in the appropriate user's manual supplied with the drive.
18. Reinsert the motor overload terminal block.
19. Connect the motor ground wire to the ground stud.

**Note:**

- Run motor cables in separate conduit.
- Do not run control wires in same conduit.
- Size motor leads per NEC.
- Provide low impedance ground.



# Enclosed NEMA Type 12/3R

**Table 6: Bypass Power Wiring Instructions — NEMA Type 12/3R (continued)**

## Control Wiring

20. Use a flat-blade screwdriver to carefully remove the low-voltage I/O terminal block.
21. Reinsert the I/O terminal block into the control board.
22. Terminate control wiring to the OPTA9 and OPTA2 board (Terminals 1 – 26).

**Note:** Use 1/8" flat-blade.

### ⚠ CAUTION

- Run 110 Vac and 24 Vdc control wiring in separate conduit.
- Communication wire to be shielded.
- RS-232 keypad cable must be less then 25 feet (to prevent nuisance trips).

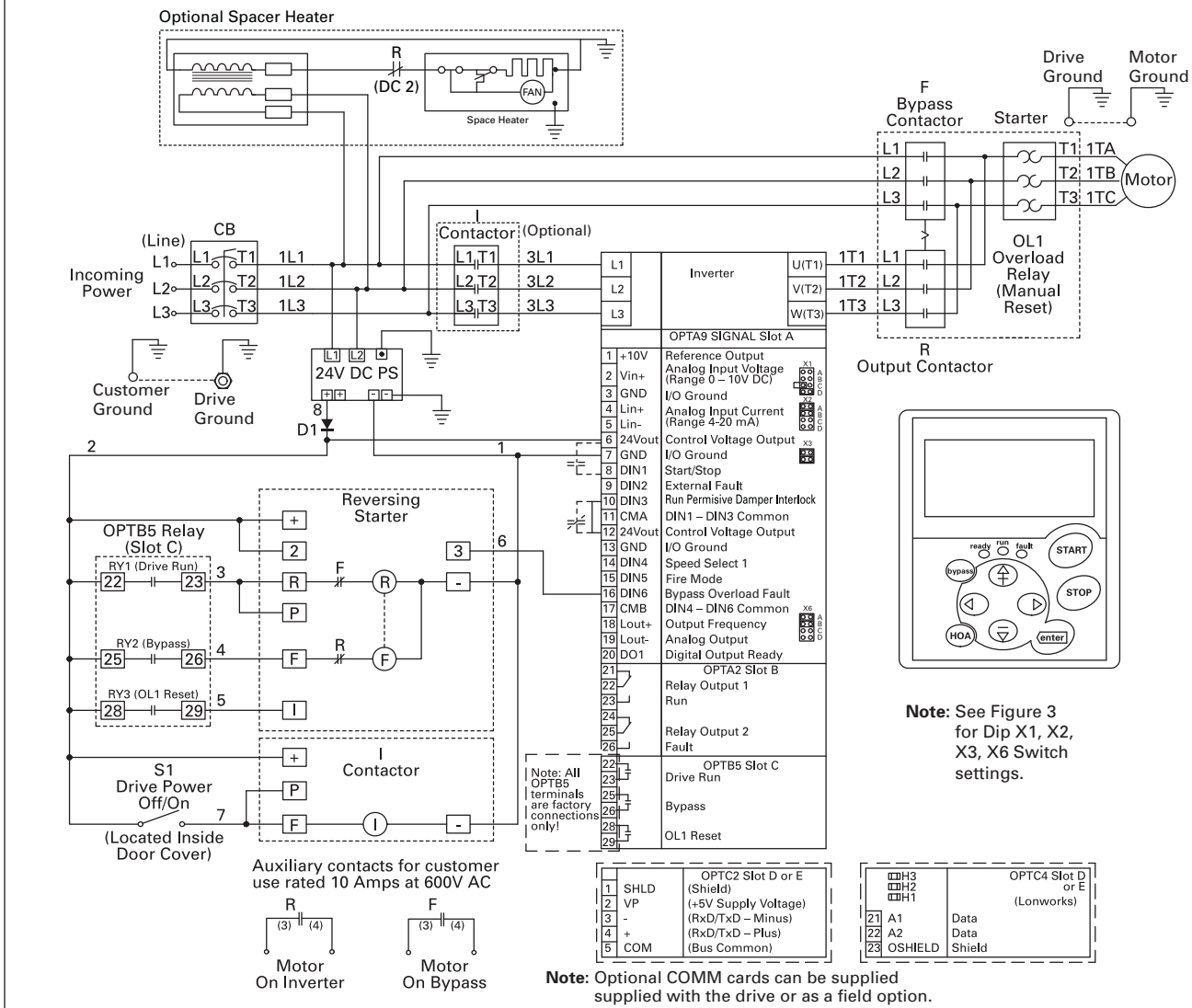
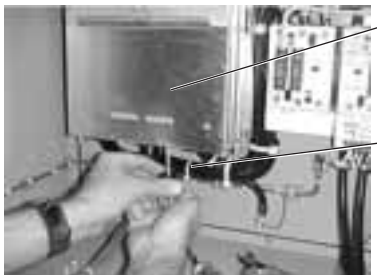



**Figure 9:**

# Enclosed NEMA Type 12/3R

**Table 6: Bypass Power Wiring Instructions — NEMA Type 12/3R (continued)**

<table>
<tr>
<td>Static Check<br><br>23. Use a Phillips screwdriver to remove all the faceplate screws on the high-voltage faceplate, and remove the faceplate.<br><br>Note: Location of the screws may vary from the drive illustrated. There may be screws securing a bottom faceplate, which also need to be removed.</td>
<td> 
</td>
</tr>
<tr>
<td>Static Check<br><br>24. Make sure power is off, and perform static checks as described in Table 7 (for the converter), Table 8 (for the inverter) and Table 9 (for the DC bus). Refer to Page 21, Appendix H.<br><br>Note: Static check shown is for L3 and B+ terminals.<br><br>25. Once the pre-power static checks are completed, reinstall the drive's outer and side covers, tightening all the screws.<br><br>⚠ WARNING<br><br>High Voltage is present on L1, L2, L3, B-, B+, BT, T1, T2, T3.</td>
<td>
</td>
</tr>
<tr>
<td>Starting Drive<br><br>26. Make sure that the drive's 3rd contactor S1 switch, if present, is in the ON position (shown in OFF position).<br><br>Note: The bypass mode operates with the switch in the OFF position, however the drive will not run. Yet the keypad will operate.<br><br>27. Reinsert the keypad cable and control board on small drives.</td>
<td> </td>
</tr>
<tr>
<td>Starting Drive<br><br>28. Close the drive door, and turn the circuit breaker handle in a clockwise direction.<br>29. Go to Appendix E for keypad operation.<br><br>Note: If the circuit breaker latch is locked, use a flat-blade screwdriver to turn the screw to release the handle.<br><br>⚠ WARNING<br><br>High Voltage<br>• Always work with another person.<br>• Be sure equipment is properly grounded.<br>• Wear safety glasses.</td>
<td> </td>
</tr>
<tr>
<td>Start-Up Wizard</td>
<td>See Appendix G.</td>
</tr>
</table>

# Appendix A — Main Control Board Wiring

## Main Control Board Wiring Default in Slot A and B

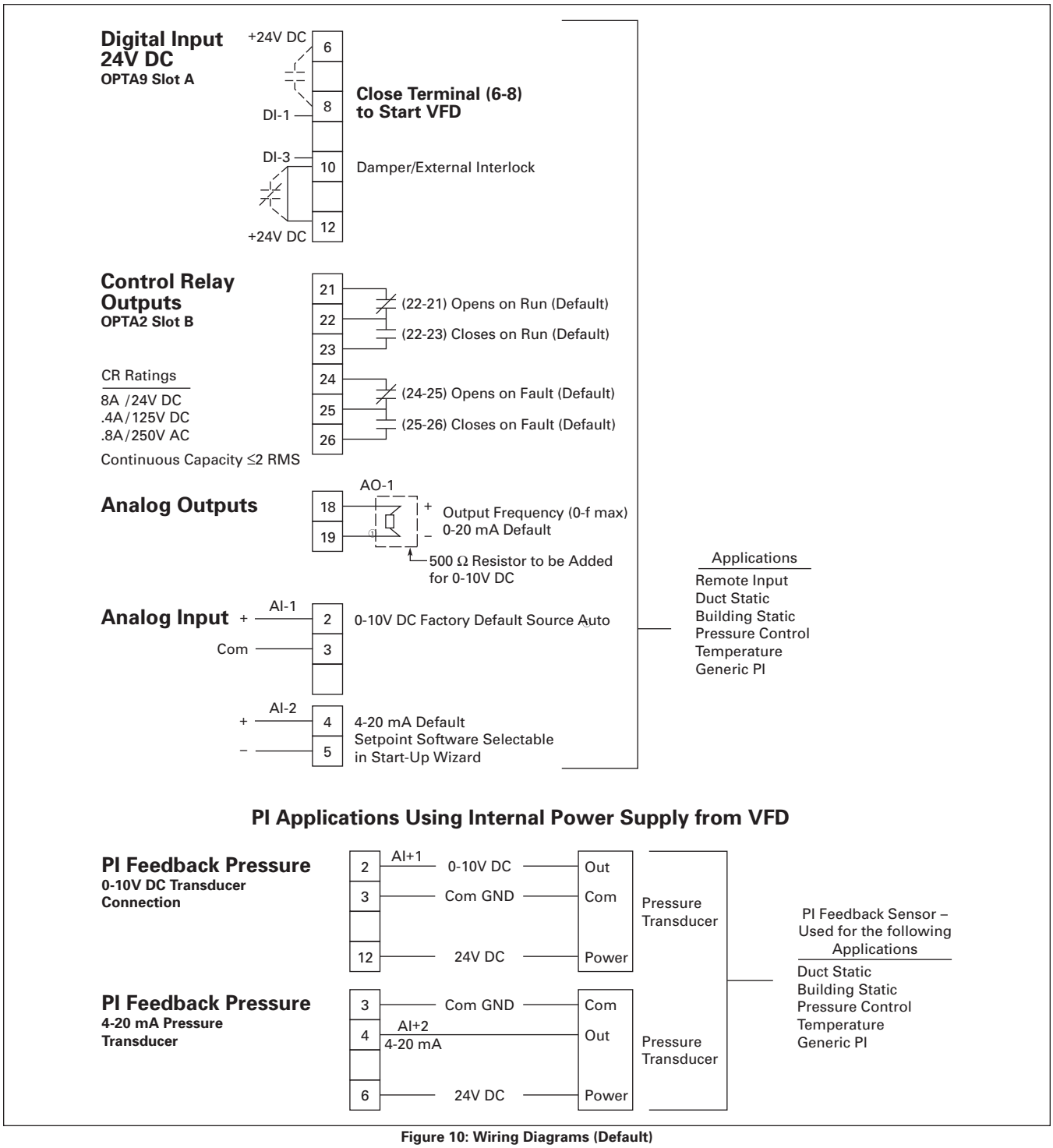



**Figure 10: Wiring Diagrams (Default)**

Card is programmable for a 0 – 10V DC with change in jumper. Add X6 jumper on Board A6 from A-B to C-D.

# Appendix B — Interlock Damper Start Example

## Interlock Damper Start Example Using 4 – 20 mA Control Signal

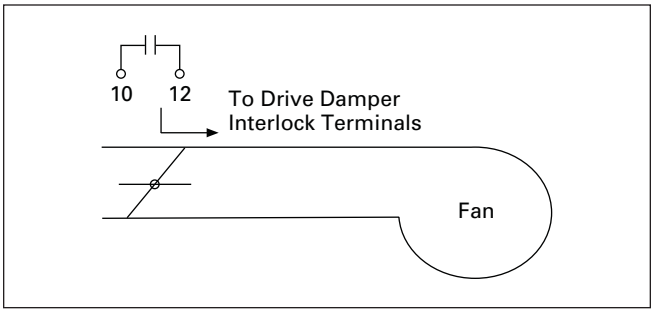



**Figure 11: Interlock Damper Start Example with Remote 4 – 20 mA Application**

Step 1. Wire Load, Line, Digital In/Out per example and verify voltage and amperage

Step 2. Static check drive SCR, IGBT, DC Bus per Static Check, Page 20 and 21

Step 3. Start-up Wizard (Remote Input Application)

Step. 4. Set Interlock Start P1.2.1 (Programmable Options)

0. Normal start with Interlock

**1. Interlock start from one D1-2….D1-6 (D1-3 Default)**

2. Interlock start and timeout supervision. If feedback is not given in timeout request, the unit will not start.

3. Delay start from Run command

**Note:** Interlock damper controller works in drive or bypass.

Step 5. Select Hand (HOA) to test motor rotation

Step 6. To verify proper motor rotation, press start and (△+) to increase speed in Hand mode

Step 7. To run in Remote Auto mode, run Remote Auto – Hit stop

Hit (HOA) twice, enter

Send START Signal from Field Controller to start drive.

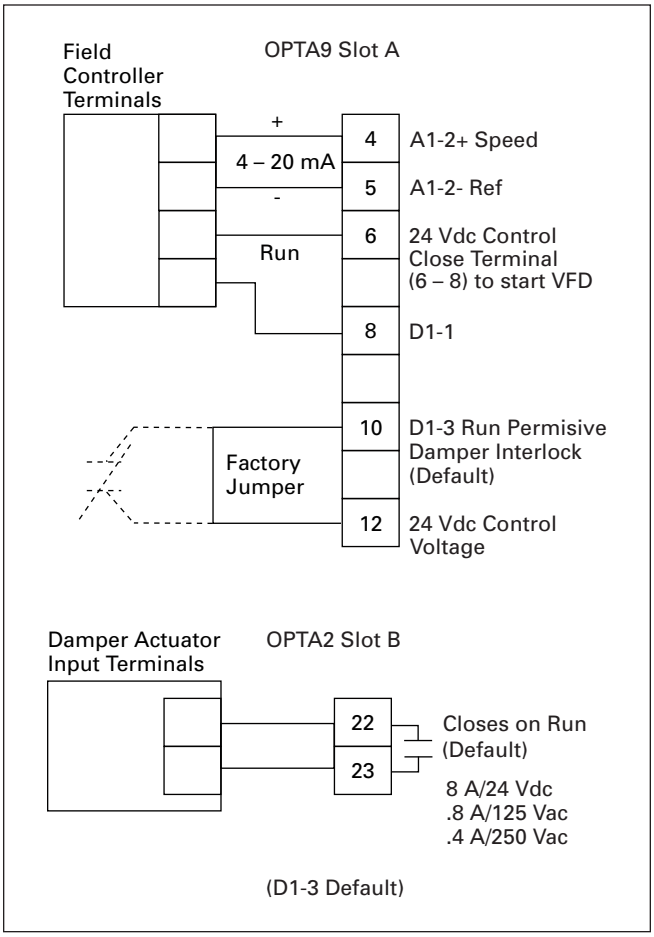



**Figure 12: Programming Example**

# Appendix C — Interlock Damper Start Example

## Interlock Damper Start Example Using PID Duct Static Control Signal

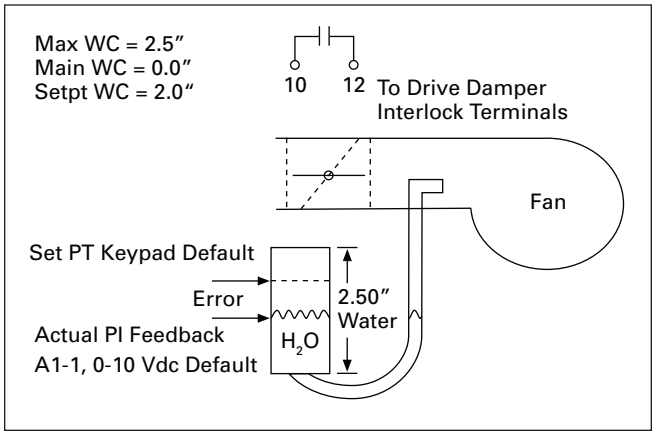



**Figure 13: Interlock Damper Start with PID Duct Static Example**

Step 1. Wire load line, digital I/O per example and verify voltage and amperage

Step 2. Static check drive SCR, IGBT, DC Bus per Static Check, Page 20 and 21

Step 3. Start-up wizard (Duct static application)

Step 4. Select hand (HOA) to check motor rotation

Step 5. Press Start and (△+) to increase speed in Hand mode

Step 6. Select Remote (HOA) to run in Auto

Step 7. Tune PID per diagram below

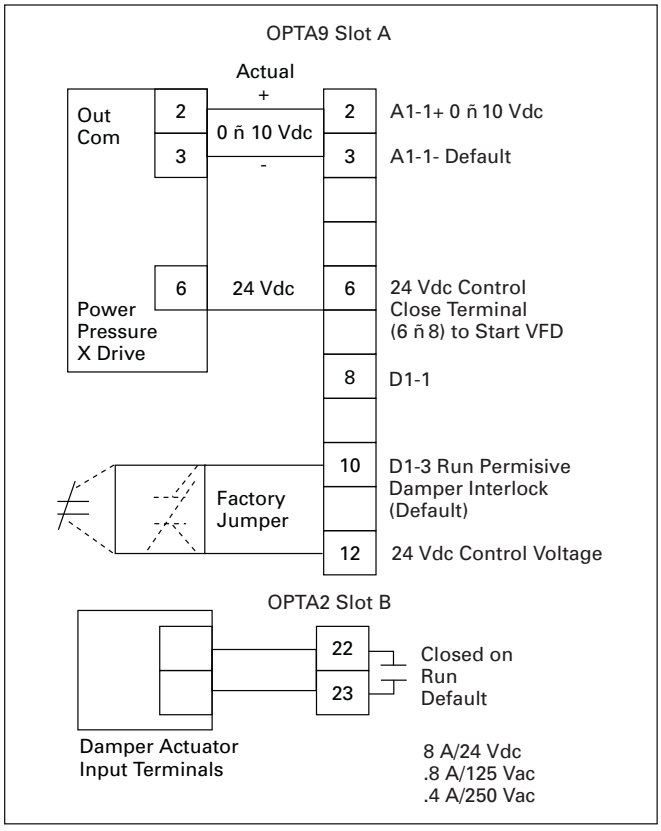



**Figure 14:**

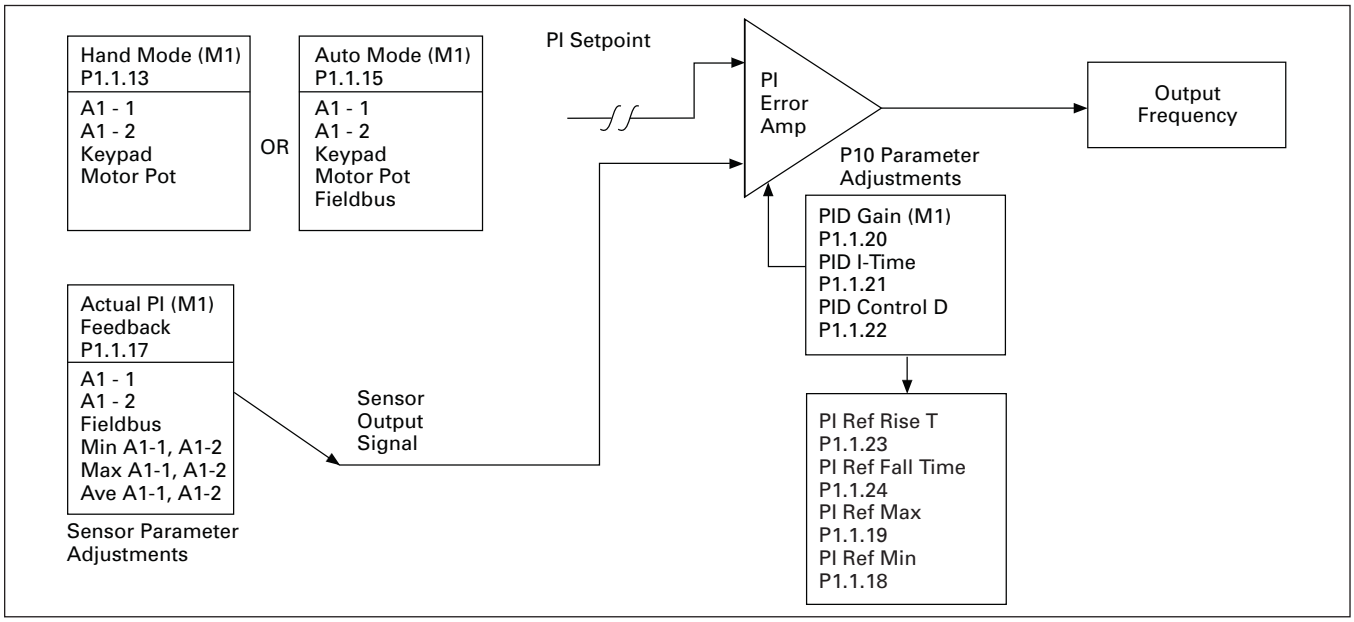



**Figure 15: PID Flow Chart**

# Appendix D — Bypass Wiring Diagram

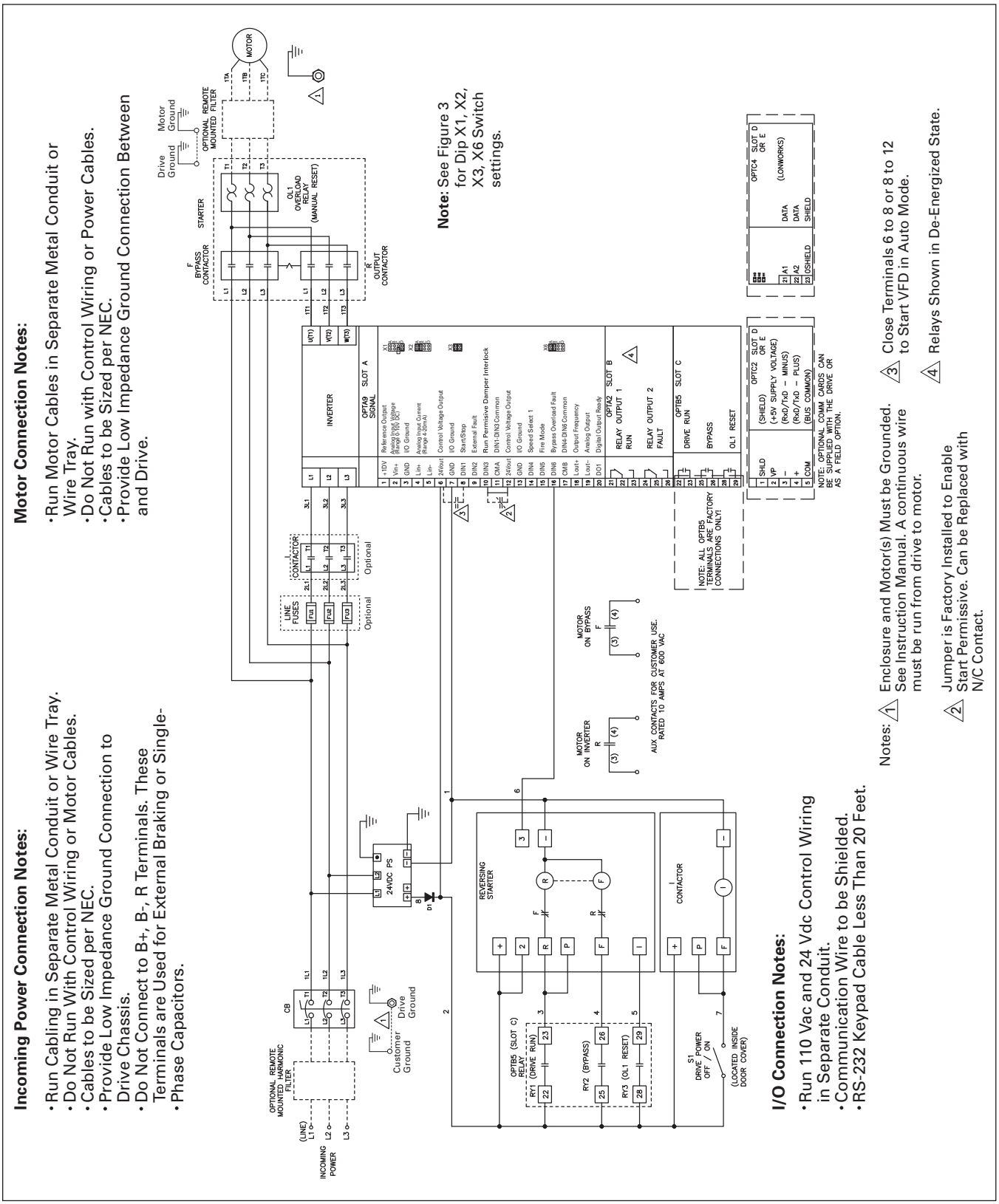

**Incoming Power Connection Notes:**
• Run Cabling in Separate Metal Conduit or Wire Tray.
• Do Not Run With Control Wiring or Motor Cables.
• Cables to be Sized per NEC.
• Provide Low Impedance Ground Connection to Drive Chassis.
• Do Not Connect to B+, B-, R Terminals. These Terminals are Used for External Braking or Single-Phase Capacitors.
**Motor Connection Notes:**
• Run Motor Cables in Separate Metal Conduit or Wire Tray.
• Do Not Run with Control Wiring or Power Cables.
• Cables to be Sized per NEC.
• Provide Low Impedance Ground Connection Between and Drive.
**Note:** See Figure 3 for Dip X1, X2, X3, X6 Switch settings.
Notes: 1 Enclosure and Motor(s) Must be Grounded. See Instruction Manual. A continuous wire must be run from drive to motor.
2 Jumper is Factory Installed to Enable Start Permissive. Can be Replaced with N/C Contact.
3 Close Terminals 6 to 8 or 8 to 12 to Start VFD in Auto Mode.
4 Relays Shown in De-Energized State.
**I/O Connection Notes:**
• Run 110 Vac and 24 Vdc Control Wiring in Separate Conduit.
• Communication Wire to be Shielded.
• RS-232 Keypad Cable Less Than 20 Feet.
MOTOR
INVERTER
SLOT A
OPTA9
OPTA2
OPTB5
OPTC2
OPTC4
REVERSING STARTER
CONTACTOR
BYPASS
STARTER
OVERLOAD RELAY (MANUAL RESET)
LINE FUSES
24VDC PS
OPTIONAL REMOTE MOUNTED HARMONIC FILTER
OPTIONAL REMOTE MOUNTED FILTER
Drive Ground
Customer Ground
INCOMING POWER
(LINE) L1
L2
L3
CB
F BYPASS CONTACTOR
R OUTPUT CONTACTOR
I CONTACTOR
Optional
MOTOR ON BYPASS F
MOTOR ON INVERTER R
AUX. CONTACTS FOR CUSTOMER USE. RATED 10 AMPS AT 600 VAC
RELAY OUTPUT 1 RUN
RELAY OUTPUT 2 FAULT
DRIVE RUN
OL1 RESET
RY1 (DRIVE RUN)
RY2 (BYPASS)
RY3 (OL1 RESET)
S1 DRIVE POWER OFF / ON
(LOCATED INSIDE DOOR COVER)
NOTE: ALL OPTB5 TERMINALS ARE FACTORY CONNECTIONS ONLY!
NOTE: OPTIONAL COMM CARDS CAN BE SUPPLIED WITH THE DRIVE OR AS A FIELD OPTION.
Reference Output
Analog Input Voltage or Current
Analog Input Current
Control Voltage Output
I/O Ground
Start/Stop
External Fault
Run Permissive Damper Interlock
Control Voltage Output
I/O Ground
Speed Select 1
Fire Mode
Bypass Overload Fault
Output Frequency
Analog Output
Digital Output Ready
(SHIELD)
(+5V SUPPLY VOLTAGE)
(RxD/TxD – MINUS)
(RxD/TxD – PLUS)
(BUS COMMON)
DATA
DATA
SHIELD
(LONWORKS)

**Figure 16:**

# Appendix E — Keypad Navigation

## Keypad Navigation

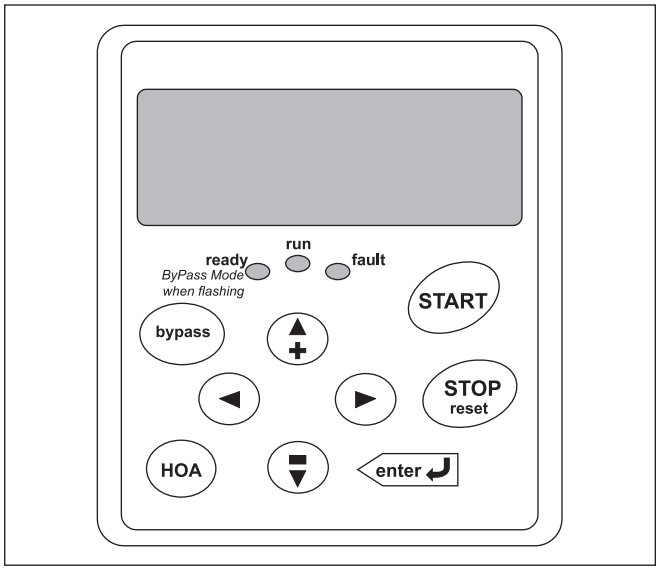



**Figure 17: Keypad and Display**

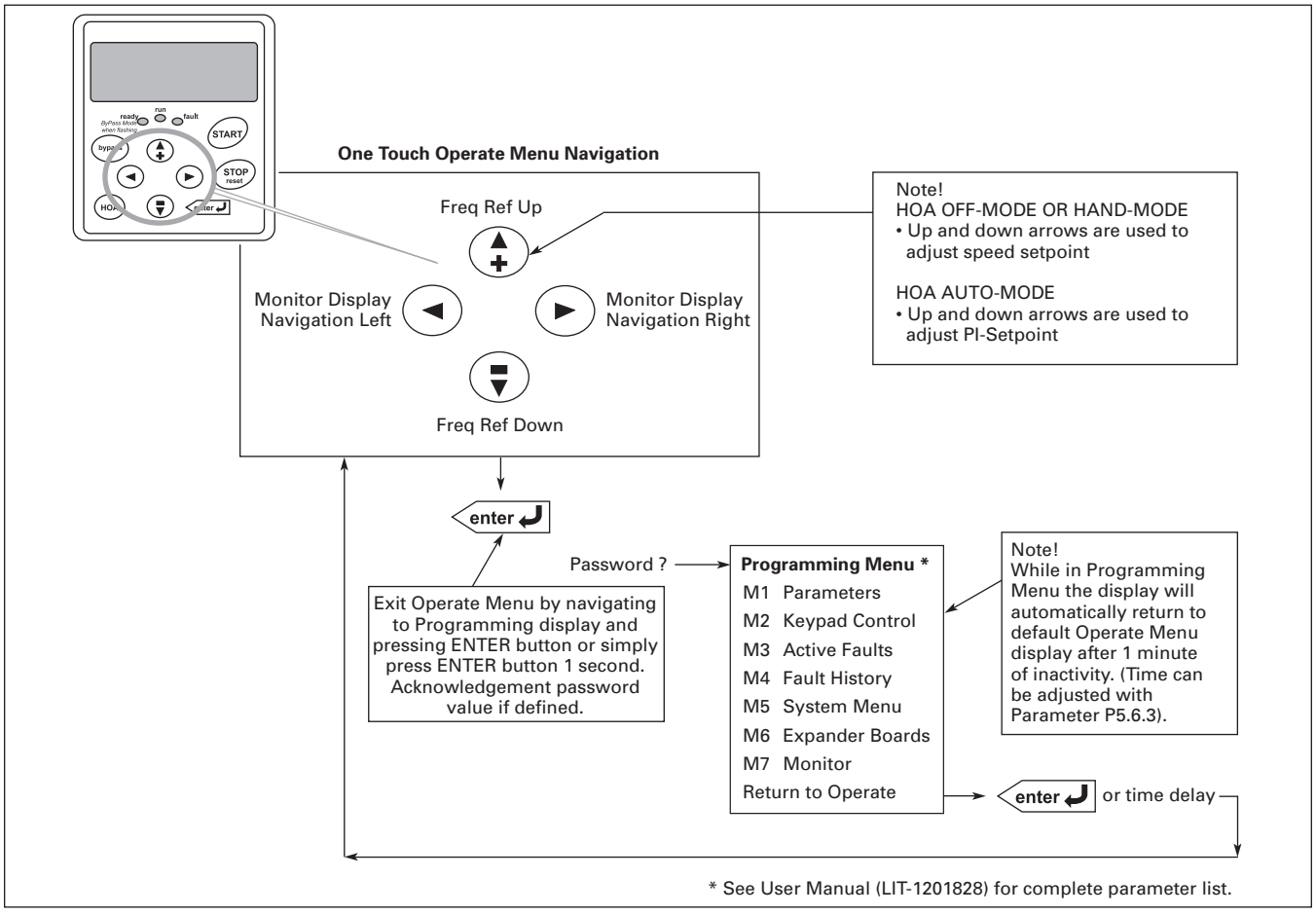

One Touch Operate Menu Navigation
Freq Ref Up
Monitor Display
Navigation Left
Monitor Display
Navigation Right
Freq Ref Down
Note!
HOA OFF-MODE OR HAND-MODE
• Up and down arrows are used to adjust speed setpoint
HOA AUTO-MODE
• Up and down arrows are used to adjust PI-Setpoint
enter
Password ?
Programming Menu *
M1 Parameters
M2 Keypad Control
M3 Active Faults
M4 Fault History
M5 System Menu
M6 Expander Boards
M7 Monitor
Return to Operate
Note!
While in Programming Menu the display will automatically return to default Operate Menu display after 1 minute of inactivity. (Time can be adjusted with Parameter P5.6.3).
enter
or time delay
Exit Operate Menu by navigating to Programming display and pressing ENTER button or simply press ENTER button 1 second. Acknowledgement password value if defined.
* See User Manual (LIT-1201828) for complete parameter list.

**Figure 18: Operate Menu Navigation**

# Appendix F — Main Menu Navigation

## Main Menu Navigation

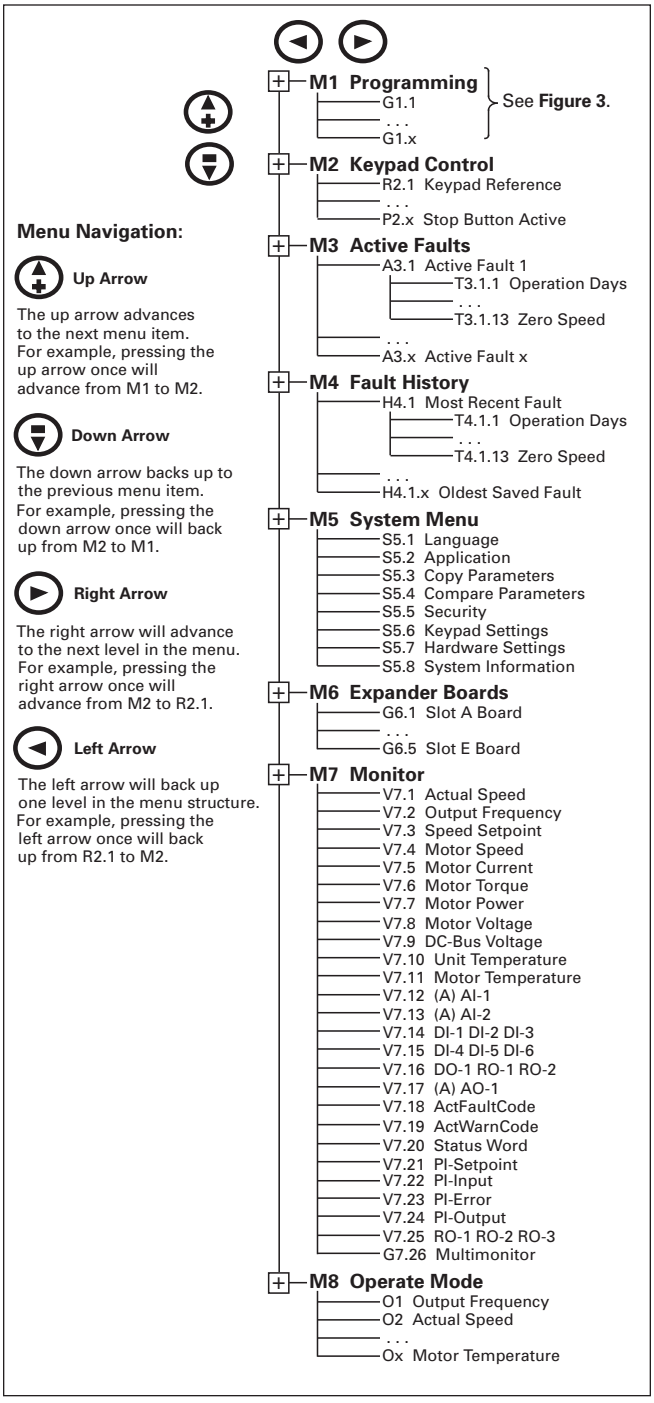

M1 Programming
G1.1
. . .
G1.x
See Figure 3.
M2 Keypad Control
R2.1 Keypad Reference
. . .
P2.x Stop Button Active
M3 Active Faults
A3.1 Active Fault 1
T3.1.1 Operation Days
. . .
T3.1.13 Zero Speed
. . .
A3.x Active Fault x
M4 Fault History
H4.1 Most Recent Fault
T4.1.1 Operation Days
. . .
T4.1.13 Zero Speed
. . .
H4.1.x Oldest Saved Fault
M5 System Menu
S5.1 Language
S5.2 Application
S5.3 Copy Parameters
S5.4 Compare Parameters
S5.5 Security
S5.6 Keypad Settings
S5.7 Hardware Settings
S5.8 System Information
M6 Expander Boards
G6.1 Slot A Board
. . .
G6.5 Slot E Board
M7 Monitor
V7.1 Actual Speed
V7.2 Output Frequency
V7.3 Speed Setpoint
V7.4 Motor Speed
V7.5 Motor Current
V7.6 Motor Torque
V7.7 Motor Power
V7.8 Motor Voltage
V7.9 DC-Bus Voltage
V7.10 Unit Temperature
V7.11 Motor Temperature
V7.12 (A) AI-1
V7.13 (A) AI-2
V7.14 DI-1 DI-2 DI-3
V7.15 DI-4 DI-5 DI-6
V7.16 DO-1 RO-1 RO-2
V7.17 (A) AO-1
V7.18 ActFaultCode
V7.19 ActWarnCode
V7.20 Status Word
V7.21 PI-Setpoint
V7.22 PI-Input
V7.23 PI-Error
V7.24 PI-Output
V7.25 RO-1 RO-2 RO-3
G7.26 Multimonitor
M8 Operate Mode
O1 Output Frequency
O2 Actual Speed
. . .
Ox Motor Temperature
Menu Navigation:
Up Arrow
The up arrow advances to the next menu item. For example, pressing the up arrow once will advance from M1 to M2.
Down Arrow
The down arrow backs up to the previous menu item. For example, pressing the down arrow once will back up from M2 to M1.
Right Arrow
The right arrow will advance to the next level in the menu. For example, pressing the right arrow once will advance from M2 to R2.1.
Left Arrow
The left arrow will back up one level in the menu structure. For example, pressing the left arrow once will back up from R2.1 to M2.

**Figure 19: Main Menu Navigation**

## Parameter Menu Structure Example

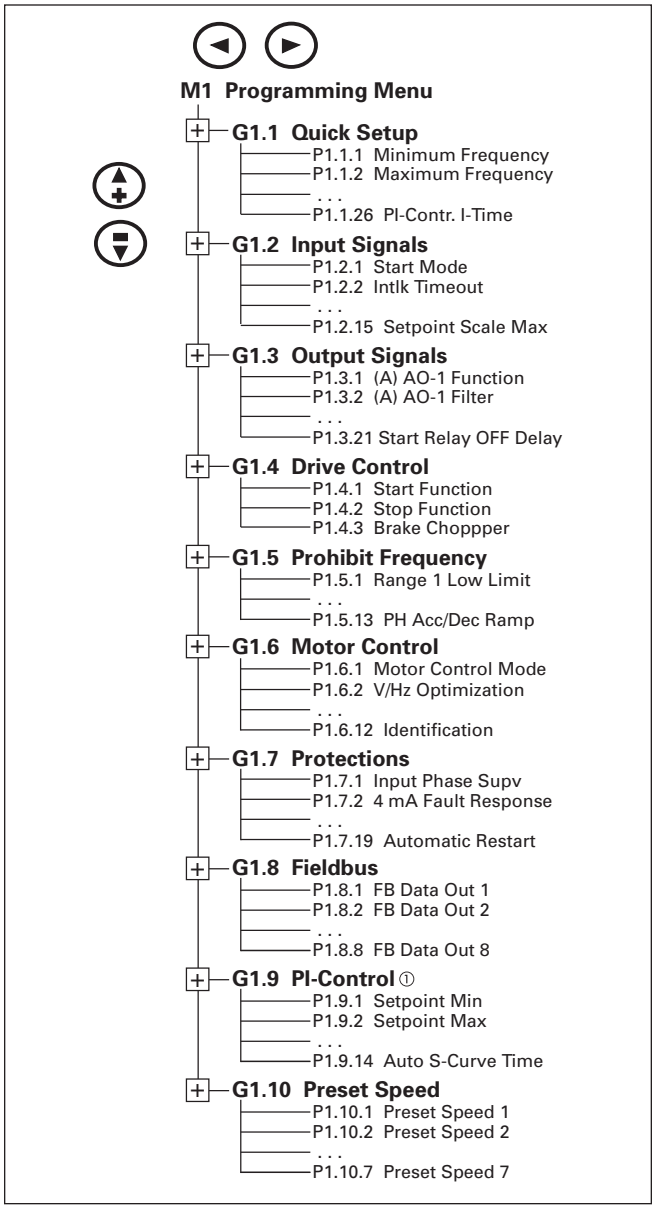



**Figure 20: Parameter Menu Structure Example**

# Appendix G — Start-Up Wizard

## Start-Up Wizard

### *Duct Static, Building Static, Pressure Control, Temperature Control, Generic PI*

Upon initial power up, the **Start-Up Wizard** guides the commissioner through the basic VSD Series setup. The **Start-Up Wizard** may be set to function upon power up by setting parameter P5.5.3, or by pressing the STOP/RESET button for 5 seconds while in the "Operate Menu". The display will read "Start-Up Wizard Activate!" after 5 seconds.

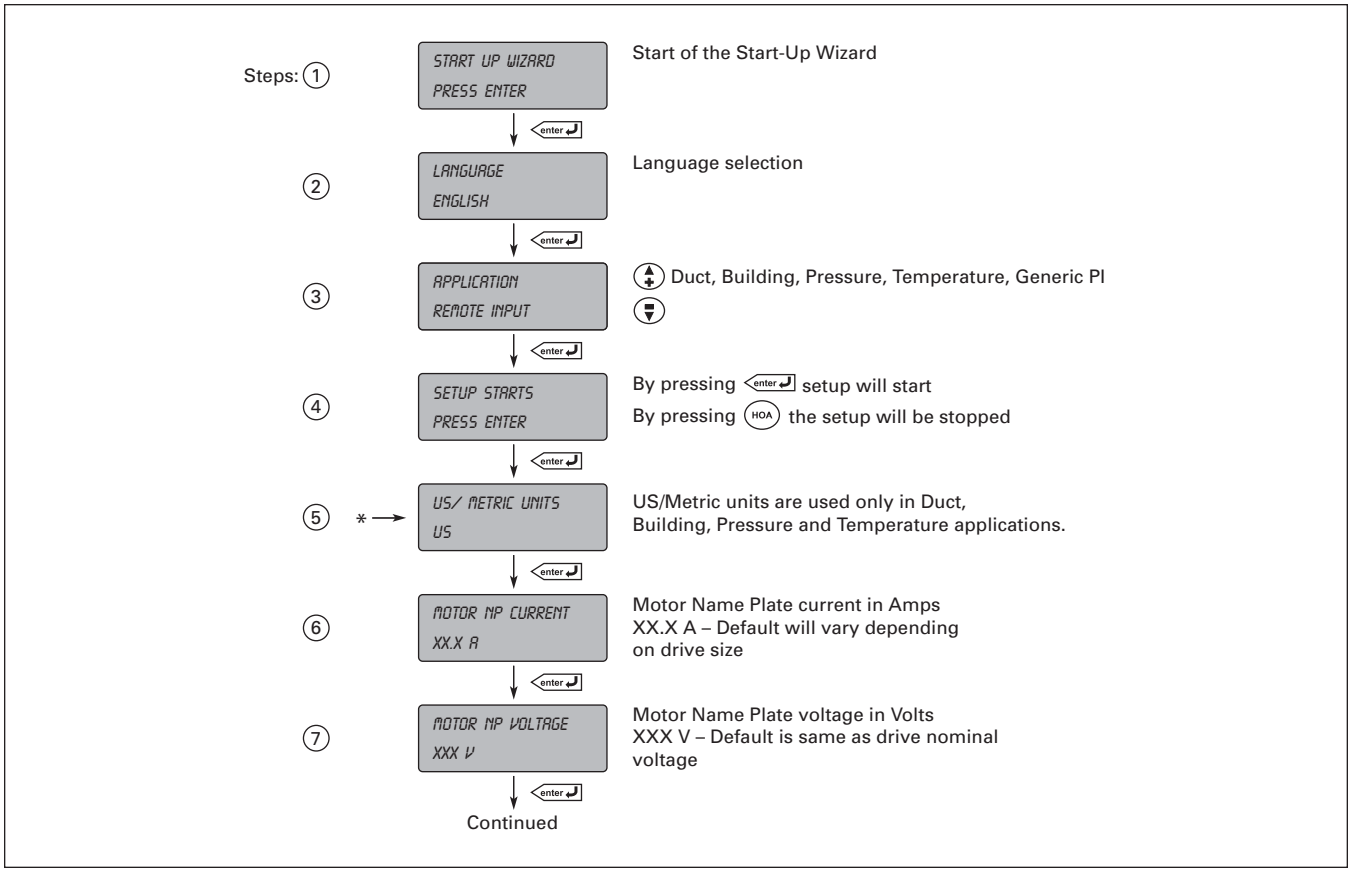



**Figure 21: Start-Up Wizard Navigation (1 of 3)**

**Note:** Use ↑↓ for changing parameter. Then press ENTER to save and move forward.

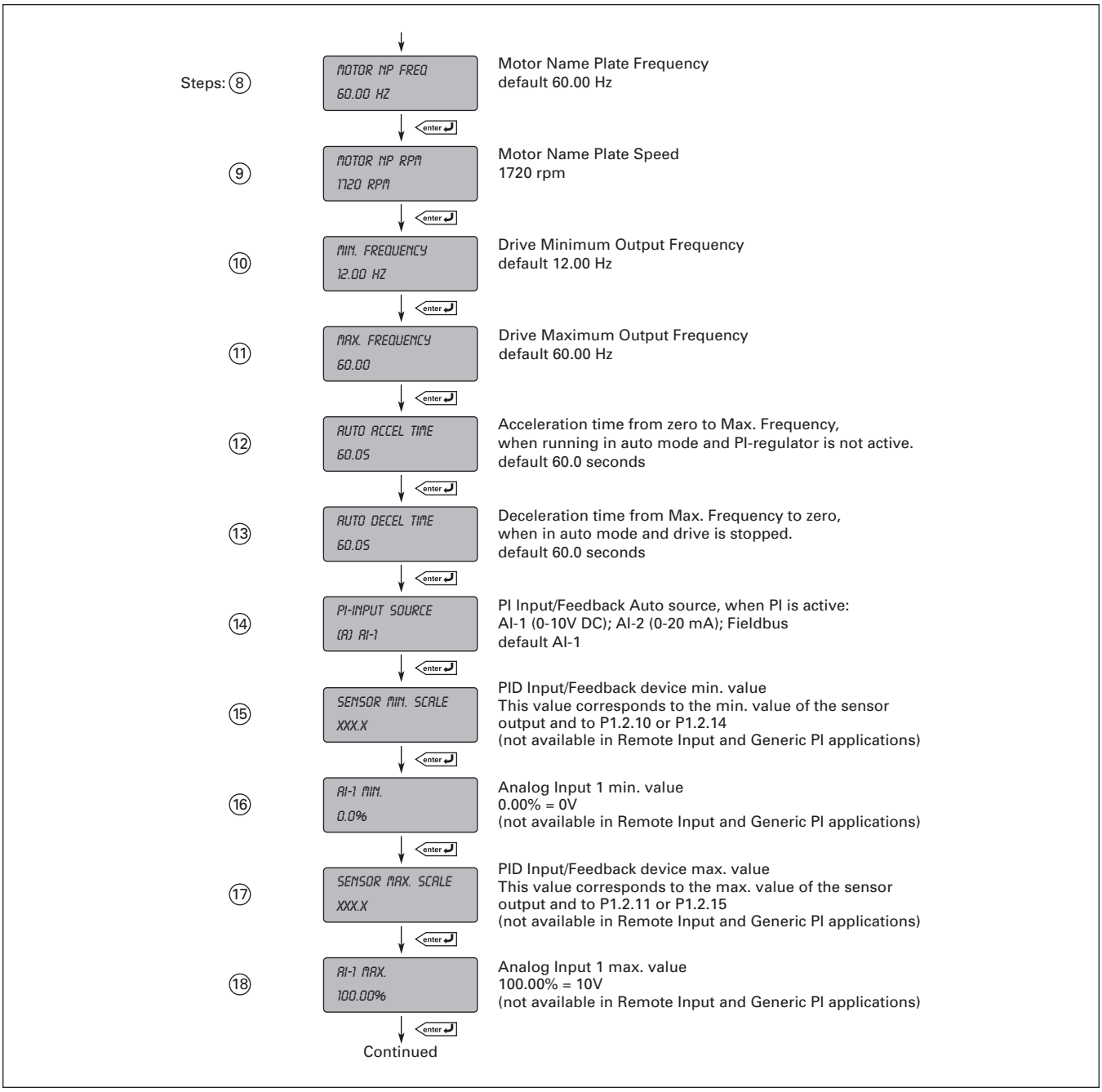



**Figure 22: Start-Up Wizard Navigation (2 of 3)**

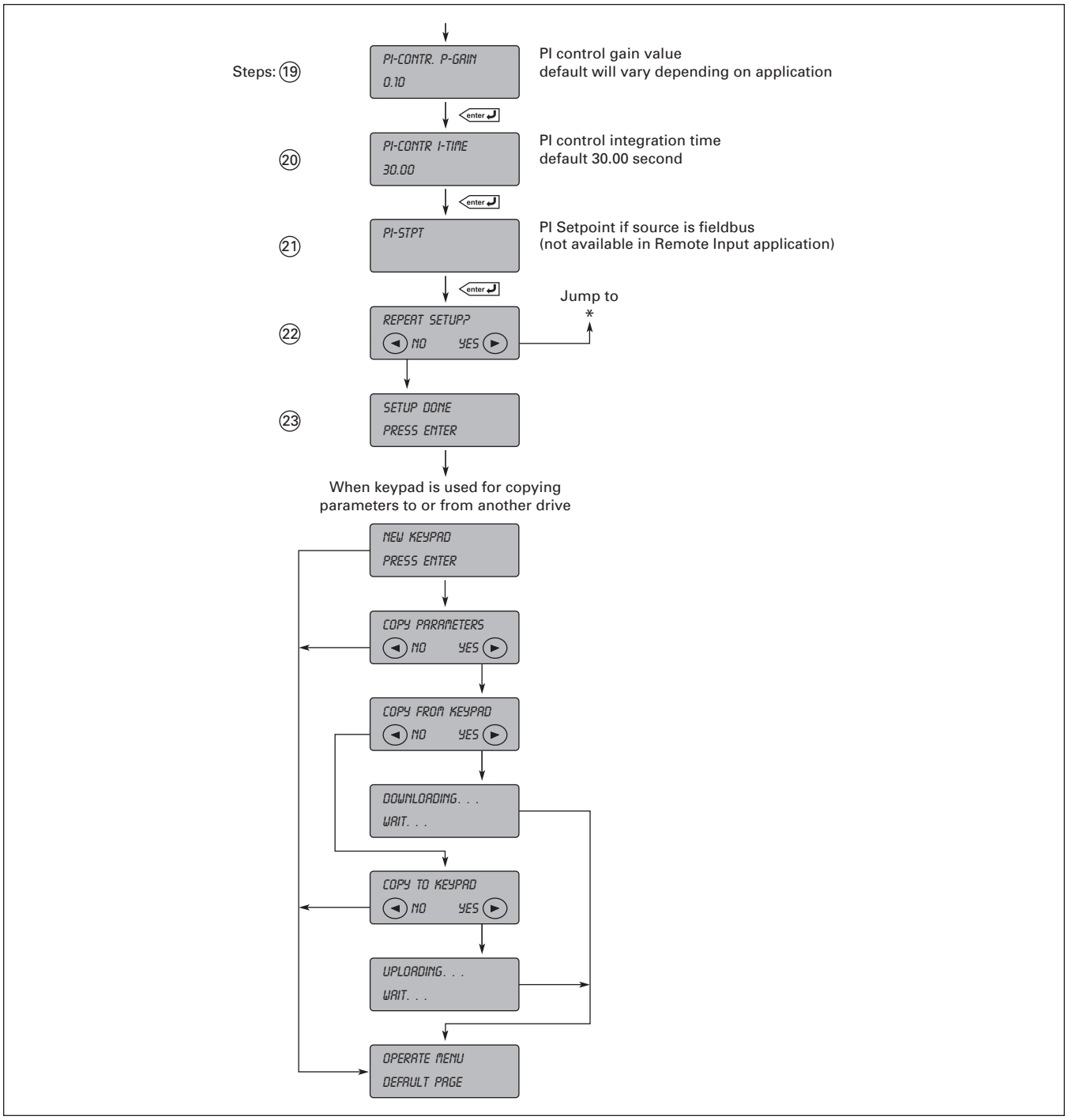



**Figure 23: Start-Up Wizard Navigation (3 of 3)**

**Note:** Start-Up Wizard can be cancelled with the STOP/RESET button. If pressed, the text "EXIT?" is shown on the display along with "No" and "Yes".

**Note:** In Pressure Control application, inverse selection is an option.

### *Remote Input Application*

The Remote Input application uses a slightly different Start-Up Wizard:

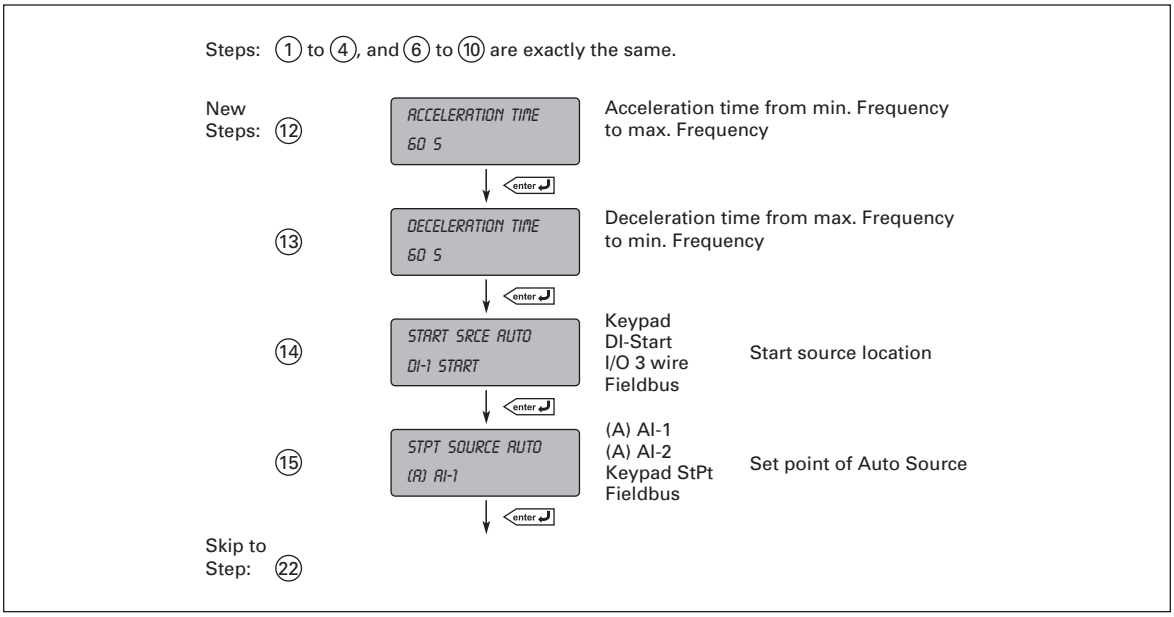



**Figure 24: Remote Input Start-Up Wizard**

# Appendix H — Static Checking

## *Static Checking*

Static checking tests the integrity of the power-carrying components (diodes, capacitors and IGBTs) within the drive assembly. Performing these static checks ensures that no damage occurred during shipping or installation that could cause a failure when the drive is powered.

Make sure there is no power to the drive before proceeding with any of the static checks.

After checking each set of terminals, zero out the multimeter by touching the metal tips of the red (positive) and black (negative) leads to each other.

**Note:** Set the multimeter to the diode function, and check each power terminal consecutively with each DC bus terminal as indicated in **Table 7**.

**Table 7: Static Checks of Converter**

| DC Bus Terminal | Power Terminal | | | Multimeter Reading |
|---|---|---|---|---|
| | L1 | L2 | L3 | |
| B+ (1st Overload Check)<br>Insert red (+) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | .OL |
| B- (2nd Overload Check)<br>Insert black (-) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | .OL |
| B- (1st Voltage Check)<br>Insert red (+) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | .25 – .55V DC (±10%) |
| B+ (2nd Voltage Check)<br>Insert black (-) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | .25 – .55V DC (±10%) |

**Note:** Set the multimeter to the diode function, and check each motor terminal consecutively with each DC bus terminal as indicated in **Table 8**.

**Table 8: Static Checks of Inverter**

| DC Bus Terminal | Motor Terminal on Contactor if Bypass or Output Contactor | | | Multimeter Reading |
|---|---|---|---|---|
| | T1 | T2 | T3 | |
| B+ (1st Overload Check)<br>Insert red (+) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | .OL |
| B- (2nd Overload Check)<br>Insert black (-) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | .OL |
| B- (1st Voltage Check)<br>Insert red (+) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | Insert black (-) multimeter lead. | .25 – .40V DC (±10%) |
| B+ (2nd Voltage Check)<br>Insert black (-) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | Insert red (+) multimeter lead. | .25 – .40V DC (±10%) |

# Appendix H — Static Checking, continued

**Note:** Set the multimeter to the ohm function, and check the power gµround terminal and DC bus terminals as indicated in **Table 9**.

**Note:** Frame 6 and larger use a "Hybrid" rectifier section. "Shown in Service Manual." Readings will be different when taking measurements from (B+) DC.

**Table 9: Static Checks of DC Bus**

| DC Bus Terminal | DC Bus Terminal (B-) | Ground Terminal (Power) | Multimeter Reading |
|---|---|---|---|
| B+ (Overload Check)<br>Insert red (+) multimeter lead. | Insert black (-) multimeter lead. | Not used. | .OL |
| B+ (1st Ohm Check)<br>Insert black (-) multimeter lead. | Not used. | Insert red (+) multimeter lead. | O.L |
| B- (2nd Ohm Check)<br>Insert black (-) multimeter lead. | Not used. | Insert red (+) multimeter lead. | O.L |

**Figure 25** is a detailed schematic to aid in performing the static checks.

## Continuity Test to Ground

Test L1, L2, L3 to ground.
T1, T2, T3 to ground.

This should read .OL ohms.

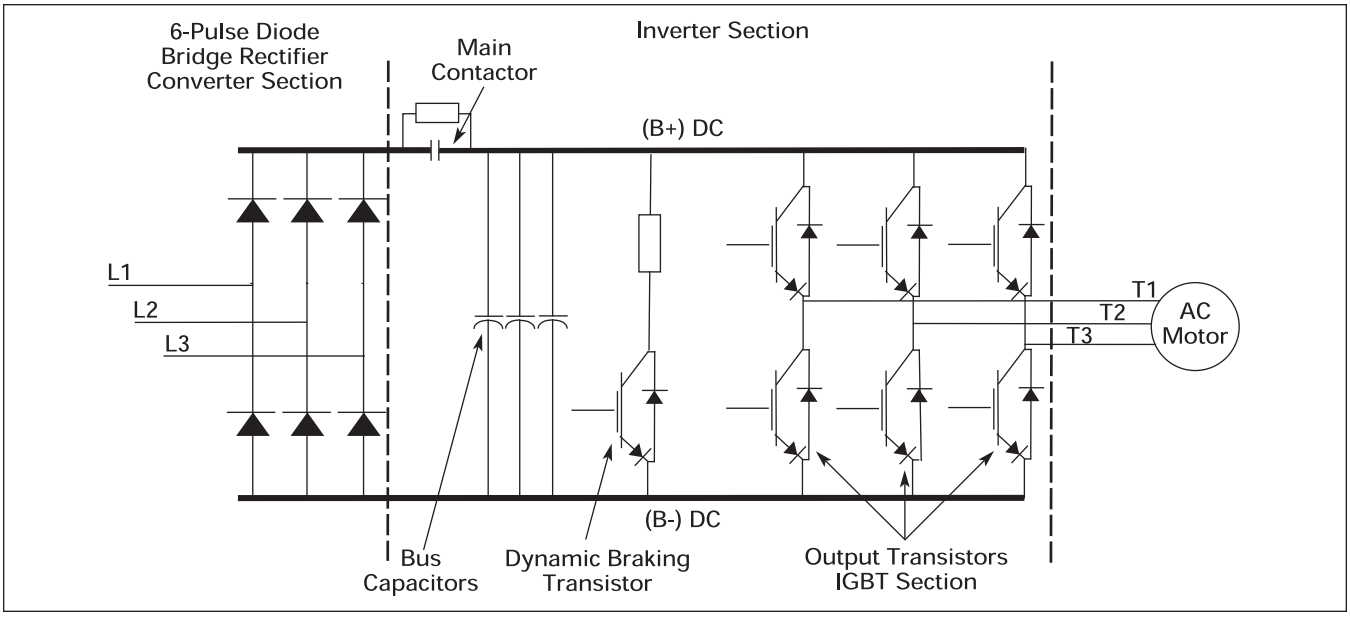



**Figure 25: Schematic for Static Checks (Sample for Frames 4 and 5)**

# Appendix I — Fault and Warning Codes

**Table 10: Fault and Warning Codes/Solutions**

| Fault Code | Fault | Possible Cause | Solution |
|---|---|---|---|
| 1 | Overcurrent | VSD Series drive has detected a high current (>4x$I_n$) in its output due to:<br>• sudden heavy load increase<br>• short in the motor<br>• short in the cables to the motor<br>• unsuitable motor | Check loading.<br>Check motor.<br>Check cables. |
| 2 | Overvoltage | The DC-link voltage has exceeded its high limit due to:<br>• too short a deceleration time<br>• high voltage levels or surges in the utility supply | Make the deceleration time longer.<br>Use brake chopper and brake resistor (standard on some models, available as options on others).<br>Correct utility supply voltage (level is too high).<br>Add input impedance to limit surges. |
| 3 | Ground (Earth) Fault | Current sensing indicates that the sum of motor phase currents is not zero.<br>• insulation failure in motor or motor cables | Check motor and motor cables. |
| 5 | Charging Switch | The charging switch was open, when the START command was given due to:<br>• faulty operation<br>• component failure | Reset the fault and restart. Should the fault re-occur, contact your Johnson Controls distributor. |
| 6 | Emergency stop | An Emergency stop signal was received from one of the digital inputs | Determine reason for the Emergency stop and remedy it. |
| 7 | Saturation trip | • defective component<br>• motor or motor cable short | Cannot be reset from the keypad.<br>Switch off power.<br>IF THE PROBLEM IS NOT IN THE MOTOR OR ITS CABLES, DO NOT RE-CONNECT POWER!<br>Contact your Johnson Controls distributor.<br>If this fault appears simultaneously with Fault 1, check the motor and motor cables. |
| 8 | System fault | • component failure<br>• faulty operation<br>**Note:** exceptional fault data record, see Active Fault Menu for more information | Reset the fault and restart. Should the fault re-occur, contact your Johnson Controls distributor. |
| 9 | Undervoltage | DC-link voltage is less than the minimum safe operating voltage limit<br>• most probable cause: too low a utility supply voltage<br>• VSD Series internal fault | If there was a supply voltage loss or dip, reset the fault and restart the VSD Series drive. Check the supply voltage. If it was within specification at the time of the fault, an internal failure has occurred. Contact your Johnson Controls distributor. |
| 10 | Input line supervision | Input line phase is low or missing. | Check the utility supply voltage, cables and connections. |
| 11 | Output phase supervision | Current sensing indicates that there is no current in one motor phase | Check the motor cables, connections and motor. |
| 12 | Brake chopper supervision | • no brake resistor installed<br>• brake resistor is broken<br>• brake chopper failure | Check the brake resistor. If the resistor is ok, the chopper is faulty. Contact your Johnson Controls distributor. |
| 13 | VSD Series under-temperature | Heatsink temperature is under -10°C | Provide supplemental heating or relocate the VSD Series drive to a warmer location. |
| 14 | VSD Series overtemperature | Heatsink temperature is over 90°C. | An overtemperature warning is issued when the heatsink temperature exceeds 85°C, a fault occurs at 90°C. Check for the correct amount and unrestricted flow of cooling air.<br>Check the heatsink for dust or dirt buildup.<br>Check the highest ambient temperature level.<br>Make sure that the switching frequency is not set too high in relation to the ambient temperature and motor load. |
| 15 | Motor stalled | • motor or load mechanical failure<br>• load too high<br>• stall parameter settings incorrect | Check the motor, mechanical system and load level.<br>Confirm the stall parameter settings. |
| 16 | Motor overtemperature | • motor is overloaded<br>• motor overheating has been detected by VSD Series • motor temperature model | Decrease the motor load.<br>If no motor overload exists, check the temperature model parameters. |
| 17 | Motor underload | • mechanical or load problem<br>• underload parameter settings incorrect | Check the motor, check for a loose belt, broken coupling or load problems.<br>Confirm underload parameter settings. |
| 22<br>23 | EEPROM checksum fault | • Parameter save fault<br>• faulty operation<br>• component failure | Upon reset of this fault, the VSD Series drive will automatically reload the parameter default settings. Check all parameter settings after reset. If the fault reoccurs, contact your Johnson Controls distributor. |
| 25 | Microprocessor watchdog fault | • faulty operation<br>• component failure | Reset the fault and restart. If the fault reoccurs, contact your Johnson Controls distributor. |

# Appendix I — Fault and Warning Codes, continued

**Table 10: Fault and Warning Codes/Solutions (continued)**

| Fault Code | Fault | Possible Cause | Solution |
|---|---|---|---|
| 26 | Start-up prevented | Start-up of the drive has been prevented. | Check Start Enable/Interlock settings. |
| 29 | Thermistor fault | The thermistor input of an option board has detected a high motor temperature | Check the motor cooling and the motor loading.<br>Check the thermistor connection.<br>(If the thermistor input of an option board is not being used, it must be short-circuited.) |
| 31 | IGBT temperature hardware | IGBT Inverter Bridge overtemperature protection has detected high short term overload current | Check loading.<br>Check motor size. |
| 32 | Fan cooling | The VSD Series cooling fan did not start when commanded | Contact your Johnson Controls distributor. |
| 34 | CAN bus communication | Sent message not acknowledged | Ensure that there is another device on the bus with the appropriate configuration. |
| 36 | Control unit | Control unit cannot control the power unit and vise-versa | Change control unit. |
| 37 | Device change | • option board changed<br>• different power rating of drive | Reset.<br>**Note:** No fault time data record! |
| 38 | Device added | • option board added<br>• drive of different power rating added | Reset.<br>**Note:** No fault time data record! |
| 39 | Device removed | • option board removed<br>• drive removed | Reset.<br>**Note:** No fault time data record! |
| 40 | Device unknown | Unknown option board or drive | Contact your Johnson Controls distributor. |
| 41 | IGBT temperature software | IGBT Inverter Bridge overtemperature protection has detected high short term overload current | Check loading.<br>Check motor size. |
| 42 | Brake resistor overtemperature | Brake resistor overtemperature protection has detected excessive braking | Set the deceleration time longer.<br>Use an external brake resistor. |
| 43 | Encoder fault | **Note:** the exceptional Fault data record. See Active Fault Menu for more information. Additional codes:<br>1 Encoder 1 channel A is missing<br>2 Encoder 1 channel B is missing<br>3 Both encoder 1 channels are missing<br>4 Encoder reversed | Check encoder channel connections.<br>Check the encoder board. |
| 50 | Analog input $I_{in}$ < 4 mA (for signal range 4 to 20 mA) | Current at the analog input is < 4 mA<br>• control cable is broken or loose<br>• signal source has failed | Check the current loop, signal source and wiring. |
| 51 | External fault | Digital input set as an external fault input has been triggered. | Check source of trigger. |
| 52 | Keypad communication fault | The connection between the control keypad and the VSD Series drive has been lost. | Check keypad connection and keypad cable. |
| 53 | Communication bus fault | The data connection between the communication bus master and the communication bus board has failed | Check installation.<br>If installation is correct, contact your Johnson Controls distributor. |
| 54 | Slot fault | Defective option board or slot | Check that the board is properly installed and seated in slot. If installation is correct, contact your Johnson Controls distributor. |
| 82 | BypassOverLoad | The motor has been overloaded while connected to the bypass | Decrease the motor load.<br>Disable the Current Imbalance feature – see the ***IT.*** manual. |



**Controls Group**
507 E. Michigan Street
P.O. Box 423
Milwaukee, WI 53201

© 2009 Johnson Controls
All Rights Reserved
Printed in USA
LIT-1201858
www.johnsoncontrols.com
November 2009